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No. 168

ANALYSES OF ROCKS, LABORATORY OF THE U. S. GEOLOGICAL SURVEY, 1880 TO 1899.—Clarke

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Joseph Hyde Pratt

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CHARLES D. WALCOTT, DIRECTOR

ANALYSES OF ROCKS

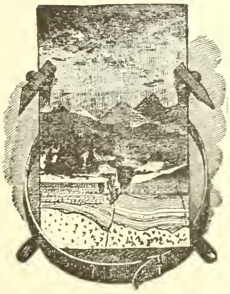
FROM THE

LABORATORY OF THE UNITED STATES GEOLOGICAL SURVEY

1880-1899

TABULATED BY

F. W. CLARKE
CHIEF CHEMIST



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LETTER OF TRANSMITTAL.

Department of the Interior,
United States Geological Survey,
Washington, D. C., February 27, 1900.

Sir: I submit herewith the manuscript for a revised and enlarged edition of Bulletin No. 148, entitled Analyses of Rocks, etc. Dr. Hillebrand's portion of the former bulletin is so much extended, and represents so distinct a demand, that it will be presented by him as a separate bulletin.

Very respectfully,

F. W. Clarke,
Chief Chemist.

Hon. Charles D. Walcott,
Director United States Geological Survey.

ANALYSES OF ROCKS, LABORATORY OF THE UNITED STATES GEOLOGICAL SURVEY, 1880-1899.

By F. W. Clarke.

INTRODUCTION.

The present Geological Survey of the United States was organized in 1879. In 1880 a chemical laboratory was established at Denver, in connection with the Colorado work, in charge of Dr. W. F. Hillebrand, with whom were associated Mr. Antony Guyard and, later, Mr. L. G. Eakins. In 1882 Dr. W. H. Melville was placed in charge of a second laboratory at San Francisco, and in the autumn of 1883 the central laboratory was started in Washington, with myself as chief chemist. In November, 1885, Dr. Hillebrand was transferred to Washington; early in 1888 he was followed by Mr. Eakins, and the Denver laboratory was discontinued. In the spring of 1890 Dr. Melville also was transferred to Washington, and since then the chemical work of the Survey has been concentrated at headquarters.

Up to January 1, 1900, nearly 4,400 analyses have been made in the laboratory at Washington. These represent rocks, minerals, ores, waters, sediments, coals, metals, and so on through all the range of substances with which geology has to do. There were also some hundreds of analyses made in the laboratories at Denver and San Francisco. A fair amount of research work upon mineralogical and analytical problems has also been done. In all of this work the following chemists have been employed: Charles Catlett, T. M. Chatard, F. W. Clarke, L. G. Eakins, F. A. Gooch, Antony Guyard, W. F. Hillebrand, W. H. Melville, R. B. Riggs, E. A. Schneider, George Steiger, H. N. Stokes, William Valentine, and J. E. Whitfield. As many as eight of these have been at work simultaneously; at present only four are connected with the Survey. Other officers of the Survey have been occupied more or less with chemical questions; but the men named in this list were connected directly with the laboratory. Some work for the chemical division has also been done by chemists not regularly on the rolls of the Survey; but their analyses, with the exception of a single group to be noted later, do not fall within the scope of this paper.

Quite naturally, on account of the activity of the petrographers, the dominant feature of the laboratory work has been the analysis of rocks. These have been studied in great numbers and in the most thorough way. The results have appeared in widely scattered publications,

official reports, monographs, bulletins, American and foreign journals, and so on. The object of this bulletin is to bring together this valuable material, together with such bibliographic and petrographic data as seems to be necessary in order to identify the specimens and to facilitate chemical discussion. Analyses of minerals have been included only when related to petrographic studies, appearing then in connection with the rocks to which they belong. Meteorites, of which twenty-seven have been analyzed, are brought into the work on account of their petrographic relations; and the groups of clays and soils have been admitted because of the bearing of these substances upon the study of slates and shales. The actual number of analyses given in the bulletin is as follows:

Igneous and crystalline rocks	854
Mineral separations	90
Meteorites, and separations from them	58
Sandstones, cherts, and sinters	48
Carbonate rocks	208
Slates and shales	48
Clays, soils, etc	98
Total	1,404

It may be observed that the classification thus indicated has not been rigorously followed. In a few instances the study of a sedimentary rock has been so related to that of its igneous neighbors that the analyses are best tabulated together; but these exceptional cases are few, and all are properly noted. The heading "igneous and crystalline rocks" has been used in the broadest and most liberal way, and doubtless many of the analyses given under it might properly be otherwise classified. In such cases of uncertainty, convenience has furnished the rule to follow.

Within each division of the analyses the classification chosen has been geographic. The petrographic grouping of the rocks would doubtless be best were petrographers agreed upon it; but their differences are many, and the chemist will do well to avoid them. The geographic method, moreover, has some advantages of its own; it facilitates the study of areas, it simplifies the bibliographic references, and it brings together, in great measure, the work of each petrographer for whom analyses have been made. Thus, most of Diller's work has been in California, most of Cross's in Colorado, and most of Iddings's in the Yellowstone National Park, and in each case the analyses are massed, and their discussion is practically uniform in character. As regards nomenclature, each rock has received the designation given it by its describer, and no liberties have been taken. This plan may cause some lack of uniformity; but no other procedure seemed to be practicable.

It will be noticed by anyone who uses this bulletin that the analyses vary as regards completeness. Among the sedimentary rocks, espe-

cially, partial analyses are common; but in the igneous group thoroughness is more general. In the early days of the chemical division many analyses were made along the older lines, just as they are still made in many laboratories to-day—that is, only the main constituents, those having direct petrographic significance, were determined. In such analyses the minor ingredients, like titanium, phosphorus, barium, strontium, chlorine, etc., were ignored; and, although the results are satisfactory in some respects, they leave much to be desired. Latterly, greater completeness has been sought for, the work done has been much fuller, and the data obtained can be discussed with much higher approaches to accuracy. The old form of "complete analysis" is to be discouraged; it leads too often to erroneous conclusions; and only the best modern methods of work and of statement should be tolerated. The fuller analyses, moreover, have brought some interesting points to light; titanium now appears to be one of the more abundant elements, and barium and strontium are found to be almost universally diffused in igneous rocks in quite perceptible quantities.

On general principles the analysis of a rock and its petrographic description should be two parts of the same investigation, matching each other completely. In practice, however, this rule does not always hold, and the departures from it are in two opposite directions. For example, an analysis of the older type says nothing of titanium and phosphorus, while the microscope reveals the presence of sphene and apatite. In this case the petrographer has been more thorough than the chemist. On the other hand, a full and perfect analysis may be given, accompanied by a petrographic description of the most general kind, in which only the main mineral constituents of the rock are noted. Here the analysis has been incompletely used, and the petrographic discussion is defective. It is hoped that the publication of this material may lead to a clearer recognition of the mutuality which should exist between the chemical and the microscopic researches, and so bring, in the future, both lines of investigation more into harmony. Hitherto the chemist and the petrographer have worked too much apart, and each has too often misunderstood the purpose of the other. If the study of the thin section could always precede the analysis, the petrographic problems could be stated more clearly, and the chemical evidence might be rendered much more pertinent and satisfactory.

In a paper published some years ago,[1] on the relative abundance of the chemical elements, I computed the average composition of the primitive crust of the earth from 880 analyses of eruptive and crystalline rocks. Of these analyses only 207 were from the laboratories of the survey, while 673 were collected from various other American and foreign sources. A large proportion of them were incomplete, regarded from a modern point of view, and yet the results obtained were fairly conclusive. The material now available for similar discussion is much

[1] Bull. U. S. Geol. Survey No. 78, 1891, p. 34.

better than that which was formerly used, and an average based upon it may not be out of place here.

In the bulletin now presented there are 830 complete analyses of rocks which are suitable for my purpose. I have also taken from the partial analyses given in the laboratory records 180 additional determinations of silica, 90 of lime, and 130 of alkalies. In 490 of the analyses there is discrimination between the water lost below 110° and that which is essential to the composition of the rocks; and this amounts to 0.40 per cent. Omitting this water, the average found may fairly represent the composition of the older crust of the earth, as deduced from a mass of data which are reasonably uniform in character and entitled to a high degree of credence. The mean for the more important constituents is as follows, with the old average given in a parallel column for comparison:

	New mean.	Old mean.
SiO_2	59.71	58.59
Al_2O_3	15.41	15.04
Fe_2O_3	2.63	3.94
FeO	3.52	3.48
CaO	4.90	5.29
MgO	4.36	4.49
K_2O	2.80	2.90
Na_2O	3.55	3.20
H_2O	1.52	[a] 1.96
TiO_2	.60	.55
P_2O_5	.22	.22
	99.22	99.66

[a] Including hygroscopic water; probably 0.40 per cent.

If we reduce these figures to elementary form and include the minor constituents which are frequently found in rocks, and which in this laboratory are often estimated, the two averages compare as follows:

	New mean.	Old mean.
Oxygen	47.02	47.29
Silicon	28.06	27.21
Aluminum	8.16	7.81
Iron	4.64	5.46
Calcium	3.50	3.77
Magnesium	2.62	2.68
Sodium	2.63	2.36
Potassium	2.32	2.40
Titanium	.41	.33
Hydrogen	.17	.21
Carbon	.12	.22
Phosphorus	.09	.10
Manganese	.07	.08
Sulphur	.07	.03
Barium	.05	.03
Strontium	.02	....
Chromium	.01	.01
Nickel	.01	....
Lithium	.01	....
Chlorine	.01	.01
Fluorine	.01	....
	100.00	100.00

As the old mean represents an attempt to measure the composition of the entire solid crust of the earth, and so includes an allowance for the carbon in the limestones, the two columns are not strictly comparable. They are, however, corroborative of each other, and show that within reasonable limits the statistical method is applicable to the problem under consideration. For the arguments upon which the discussion is based the original paper should be consulted. The distribution of the rarer elements has also been elaborately discussed by Vogt,[1] and their percentages may be regarded as small corrections to be applied to the table at some future time.

By a similar statistical process I have attempted to ascertain something with regard to the relative abundance of the more important rock-forming minerals. Nearly 500 analyses of igneous rocks were

[1] Zeitsch. Prakt. Geologie, 1898, pp. 225, 314, 377, 413; and 1899, pp. 10, 274.

discussed, and the subjoined percentages, which are probably nothing more than rough approximations to the truth, were obtained:

Quartz	12.0
Feldspars	60.0
Pyroxenes and amphiboles	18.0
Micas	4.0
	94.0

The less frequent minerals make up the remaining 6 per cent. The computation, although it is by no means conclusive, is perhaps a little more satisfactory than any similar estimate which has so far been made.

For computing the average composition of the sedimentary rocks the existing analyses of individual samples are inadequate. They are too few and too incomplete to yield any conclusions of value. Attempts have been made to partly use the data, as, for example, by Joly;[1] and it seems probable, therefore, that better material will not be without interest or scientific value.

Some five years ago, at the request of Mr. G. K. Gilbert, a series of composite analyses of sedimentary rocks was made in this laboratory. Many samples were mixed into one uniform sample, from which, by a single analysis, an average composition was determined. The material was selected and the samples were prepared by Mr. Gilbert, assisted by Mr. G. W. Stose, and the analyses were made by Dr. H. N. Stokes. The data obtained may be tabulated as follows:

A. Composite analysis of 27 Mesozoic and Cenozoic shales. Each individual shale was taken in amount roughly proportional to the mass of the formation which it represented.

B. Composite analysis of 51 Paleozoic shales, weighted as in the former case.

C. General average of A and B, giving them, respectively, weights as 3 to 5. This average represents 78 rocks.

D. Composite analysis of 253 sandstones, about one gramme of each being taken in preparing the average sample.

E. Composite analysis of 371 sandstones used for building purposes. Equal weights taken.

F. Composite analysis of 345 limestones, equal weights being taken.

G. Composite analysis of 498 limestones used for building purposes, equal weights taken.

[1] An estimate of the geological age of the earth: Sci. Trans. Royal Dublin Soc., vol. 7, p. 23, 1899.

	A.	B.	C.	D.	E.	F.	G.
SiO_2	55.43	60.15	58.38	78.66	84.86	5.19	14.09
TiO_2	.46	.76	.65	.25	.41	.06	.08
Al_2O_3	13.84	16.45	15.47	4.78	5.96	.81	1.75
Fe_2O_3	4.00	4.04	4.03	1.08	1.39	.54	.77
FeO	1.74	2.90	2.46	.30	.84	undet.	undet.
MnO	trace	trace	trace	trace	trace	.05	.03
CaO	5.96	1.41	3.12	5.52	1.05	42.61	40.60
SrO	none	none	none	trace	none	none	none
BaO	.06	.04	.05	.05	.01	none	none
MgO	2.67	2.32	2.45	1.17	.52	7.90	4.49
K_2O	2.67	3.60	3.25	1.32	1.16	.33	.58
Na_2O	1.80	1.01	1.31	.45	.76	.05	.62
Li_2O	trace	trace	trace	trace	trace	trace	trace
H_2O at 110°	2.11	.89	1.34	.31	.27	.21	.30
H_2O above 110°	3.45	3.82	3.68	[a] 1.33	[a] 1.47	[a] .56	[a] .88
P_2O_5	.20	.15	.17	.08	.06	.04	.42
CO_2	4.62	1.46	2.64	5.04	1.01	41.58	35.58
S	....	....	....	....	....	.09	.07
SO_3	.78	.58	.65	.07	.09	.05	.07
Cl	....	....	....	trace	trace	.02	.01
Carbon [b]	.69	.88	.81	....	....	....	....
	100.48	100.46	100.46	100.41	99.86	100.09	100.34

[a] Includes organic matter. [b] Of organic origin.

These analyses may be used for a variety of purposes. For example, they can help in tracing the change from an average igneous rock to an average sediment. They suggest something as to the characteristic features which distinguish a good building stone from other limestones and sandstones. They are applicable to the discussion of a variety of large theoretical problems, like that chosen by Professor Joly. These considerations alone justify their publication here.

In the former edition of this bulletin (No. 148) a chapter upon analytical methods, by Dr. W. F. Hillebrand, was included. For that chapter there has been a large separate demand, and for that reason it will be expanded into a work of greater detail and issued as a distinct bulletin. It will be noticed that to Dr. Hillebrand many of the best analyses in this compilation are due, and a full statement of methods, embodying his experience, will be of the utmost value.

During the preparation of this bulletin much assistance was rendered by the petrographers and geologists connected with the Survey, especially with reference to analyses hitherto unpublished. In each case credit has been given for the data thus added. Twenty-eight analyses

of rocks from Montana, executed by or under the direction of Prof. L. V. Pirsson, of Yale University, and having been made in connection with regular Survey work, are included in the tabulations. With this exception all of the analyses given were made in the Survey laboratories. To those executed in the laboratory at Washington "record numbers" are attached, which serve to identify them on the record books of the Division of Chemistry. Of the abbreviations used for bibliographic reference only three need explanation, and they refer to the official publications of the Survey. "Ann." for Annual Report, "Mon." for Monograph, and "Bull." for Bulletin are the three in question. The others relate to well-known journals, and are familiar to all geologists. The letters P. R. C., following the description of a rock, refer to the Petrographic Reference Collection of the Survey, and are followed by the number assigned to the rock in that series.

ANALYSES.

IGNEOUS AND CRYSTALLINE ROCKS.

MAINE.

1. ROCKS FROM AROOSTOOK COUNTY.

Described by H. E. Gregory in Bull. 165. Analyses by W. F. Hillebrand, record No. 1795.

A. Quartz-trachyte (bostonite), Quoggy Joe Mountain, Presque Isle Township. Contains quartz, orthoclase, albite, and magnetite, with siderite, kaolin, and chlorite.

B. Teschenite, Mapleton Township. In dikes cutting shales. Contains andesine, augite, biotite, apatite, analcite, and magnetite.

C. Andesite, Edmunds Hill, Chapman Township. Contains labradorite, orthoclase, pyroxene, apatite, and magnetite.

D. Calciferous sandstone, New Sweden Township. Contains calcite, alkali, feldspar, quartz, magnetite, muscovite, and siderite. Included here because studied as one of the group.

	A.	B.	C.	D.
SiO_2	72.77	46.77	61.40	54.23
Al_2O_3	12.15	14.91	16.59	7.38
Fe_2O_3	.44	7.80	2.13	.54
FeO	3.06	4.90	3.05	1.37
MgO	.22	2.94	2.73	3.29
CaO	.07	6.30	6.17	14.56
Na_2O	3.38	4.97	3.83	1.65
K_2O	4.67	2.37	1.34	1.74
H_2O at 105°	.17	.92	.82	.25
H_2O above 105°	.55	4.28	.88	1.22
TiO_2	.20	2.31	.79	.28
P_2O_5	trace	.98	.20	.07
ZrO_2	.04	none	none	(?)
Cr_2O_3	none	none	trace	(?)
V_2O_3	(?)	.02	.02	(?)
FeS_2	.12	.07	none	(?)
NiO	none	trace	trace	none
MnO	.16	.29	.13	undet.
SrO	none	.03	trace?	none
BaO	.03	.04	.02	none
CO_2	2.06	trace?	none	13.48
	100.09	99.90	100.10	100.06

Traces of lithia present in all. F and Cl not looked for.

E. Diabase (basaltic glass), Mars Hill. Not resolvable into minerals.

F. Rhyolite, Haystack Mountain. Contains quartz in a groundmass of orthoclase.

G. Volcanic tuff, southeast base of Castle Hill. Contains fragments of trachyte, andesite, devitrified glass, and lapilli.

H. Diabase, Aroostook Falls, near Maine boundary line. Dike. Contains plagioclase, pyroxene, and pyrite.

	E.	F.	G.	H.
SiO_2	42.25	75.98	31.42	49.64
Al_2O_3	16.87	12.34	11.57	15.07
Fe_2O_3	5.24	.85	2.37	1.66
FeO	10.72	.93	7.48	8.82
MgO	6.91	.15	5.32	5.43
CaO	3.33	.13	16.71	7.23
Na_2O	3.96	4.02	2.26	4.19
K_2O	.77	4.44	.74	.89
H_2O at 105°	.43	.24	.76	.45
H_2O above 105°	5.58	.64	4.17	2.81
TiO_2	2.93	.17	2.30	2.32
P_2O_5	.34	.03	.46	.29
ZrO_2	none	.03	none	none
Cr_2O_3	.03	(?)	trace	trace
V_2O_3	.07	(?)	.06	.04
FeS_2	trace	none	.16	.79
NiO	.01	none	trace	trace
MnO	.40	trace ?	.38	.25
SrO	none	trace ?	none	.05
BaO	trace ?	.07	.64	.02
CO_2	none	none	13.13	.32
	99.84	100.02	99.93	100.27

Traces of lithia present in all. Cl and F not looked for.

2. LITCHFIELDITE AND ASSOCIATED MINERALS.

A. Elæolite-syenite, var. litchfieldite, from Litchfield. Described by Bayley in Bull. 150, p. 201; and in Bull. Geol. Soc. Amer., vol. 3, p. 231. Contains elæolite, two feldspars, and lepidomelane, with sodalite, cancrinite, and zircon as accessories. Analysis by L. G. Eakins, record No. 1298. P. R. C. 77.

B. Albite from A. Sp. gr. 2.622.

C. Potash feldspar from A. Sp. gr. 2.56. Analyses B and C by W. H. Melville, record No. 1275. P. R. C. 77.

	A.	B.	C.
SiO_2	60.39	68.28	65.14
Al_2O_3	22.57	19.62	18.19
Fe_2O_3	.42	....	....
FeO	2.26	.23	.25
MgO	.13	.09	.16
CaO	.32	.31	.33
Na_2O	8.44	10.81	1.68
K_2O	4.77	.39	14.14
H_2O	.57	.09	.17
MnO	.08	....	....
	99.95	99.82	100.06

The minerals found in this rock were quite fully described by Clarke in Bull. 42, pp. 28–38. Analyses by F. W. Clarke.

D. Elæolite, dark gray.

E. Hydronephelite.

F. Lepidomelane. Contains no fluorine.

	D.	E.	F.
SiO_2	43.74	38.99	32.09
Al_2O_3	34.48	33.62	18.52
Fe_2O_3	....	....	19.49
FeO	....	....	14.10
MgO	trace	....	1.01
CaO	trace	.07	....
Na_2O	16.62	13.07	1.55
K_2O	4.55	1.12	8.12
H_2O	.86	12.98	4.62
MnO	....	....	1.42
	100.25	99.85	100.92

G. Sodalite, deep blue. P. R. C. 77.
H. Cancrinite, bright orange yellow. P. R. C. 77.
I. Cancrinite, pale yellow, cleavable.
J. Cancrinite, pale yellow, granular.

	G.	H.	I.	J.
SiO_2	37.33	36.29	35.83	37.22
Al_2O_3	31.87	30.12	29.45	28.32
Fe_2O_3	....	trace	trace	trace
MgO	....	....	....	.07
CaO	....	4.27	5.12	4.40
Na_2O	24.56	19.56	19.33	19.43
K_2O	.10	.18	.09	.18
H_2O	1.07	2.98	3.79	3.86
MnO	....	trace	trace	trace
CO_2	....	6.96	6.50	6.22
Cl	6.83	....	....	....
	101.76	100.36	100.11	99.70
O=Cl	1.54			
	100.22			

NEW HAMPSHIRE.

A. Elæolite-syenite, Red Hill, Moultonboro. Described by Bayley in Bull. Geol. Soc. Amer., vol. 3, p. 231. Contains elæolite, augite, hornblende, biotite, sodalite, albite, and orthoclase, with accessory apatite, sphene, magnetite, and an occasional zircon. Fibrous decomposition products are also present. P. R. C. 203.

B. Mixed albite and orthoclase from A.

C. Nepheline (elæolite) from A. Analyses by W. F. Hillebrand, record No. 1321. The mixed nepheline and feldspar were treated with dilute hydrochloric acid, and the residue was extracted with sodium carbonate solution. C represents the soluble part, and B the insoluble.

D. Camptonite, Campton Falls. Analysis by L. G. Eakins, record No. 1298. Described by J. P. Iddings in Bull. 150, p. 239. Contains hornblende, plagioclase, orthoclase, augite, iron ore, biotite, apatite, pyrite, and a mineral which appears to be analcite. Also variable calcite, serpentine, and chlorite P. R. C. 92.

E. Quartz-porphyry, Pemigewasset. Analysis by Eakins, No. 1298.

	A.	B.	C.	D.	E.
SiO_2	59.01	66.85	45.31	38.45	65.02
Al_2O_3	18.18	19.50	32.67	19.68	17.93
Fe_2O_3	1.63	.13	....	4.01	4.69
FeO	3.65		....	11.15	.17
MgO	1.05	trace	.16	6.65	1.24
CaO	2.40	.11	2.00	9.37	1.34
Na_2O	7.03	7.44	12.60	2.77	3.04
K_2O	5.34	5.80	5.70	1.72	5.98
H_2O at 100°	.15	....	....	1.49	.86
H_2O above 100°	.50	.31	1.56		
TiO_2	.81	....	....	....	....
P_2O_5	trace	....	....	....	....
MnO	.03	....	....	trace	.11
SrO	trace	....	....	....	....
BaO	.08	.07	....	....	....
Li_2O	trace	none	....	....	....
CO_2	.12	....	....	4.82	....
	99.98	100.21	100.00	100.11	100.38

VERMONT.

1. ROCKS OF MOUNT ASCUTNEY.

Analyses by W. F. Hillebrand, record Nos. 1621, 1657. Samples received from T. A. Jaggar, jr. Petrographic data furnished by R. A. Daly.

A. Typical granitite. Contains quartz, orthoclase, plagioclase (microperthite), biotite, magnetite, sphene, apatite, and zircon.

B. Basic segregation in granitite. Contains biotite, hornblende, quartz, plagioclase, microperthite, much sphene and apatite, some magnetite and zircon.

C. Another sample of B.

D. Syenite. Contains hornblende, augite, orthoclase, microperthite, plagioclase, biotite, quartz, magnetite, sphene, apatite, and zircon.

E. Basic segregation in syenite. Contains hornblende, augite, microperthite, orthoclase, plagioclase, quartz, magnetite, zircon, and apatite.

F. Syenite-porphyry. Contains orthoclase, quartz, hornblende, magnetite, apatite, and zircon.

	A.	B.	C.	D.	E.	F.
SiO_2	71.90	56.01	59.27	65.43	56.51	73.03
Al_2O_3	14.12	*a*15.19	15.76	16.11	16.59	13.43
Fe_2O_3	1.20	2.34	2.07	1.15	1.35	.40
FeO	.86	4.89	3.57	2.85	6.59	1.49
MgO	.33	4.67	3.04	.40	2.52	.14
CaO	1.13	4.85	3.69	1.49	4.96	.79
Na_2O	4.52	5.66	5.63	5.00	5.15	4.91
K_2O	4.81	2.16	3.33	5.97	3.05	4.54
H_2O at 110°	.18	.36	.23	.19	.21	.18
H_2O above 100°	.42	.90	.74	.39	.71	.35
TiO_2	.35	1.13	1.12	.50	1.20	.30
P_2O_5	.11	.53	.42	.13	.41	.06
ZrO_2	.04	....	.04	.11	.04	.06
MnO	.05	.40	.37	.23	.24	.15
(NiCo)O	none	.03	trace	(?)	trace?	(?)
BaO	.04	trace?	trace?	.03	.03	trace
CO_2	.21	undet.	.30	trace?	.33	trace?
F	.06	undet.	.42	.08	.24	.08
Cl	.02	undet.	.03	.05	.07	.03
FeS_2	trace	.09	.07	.07	.06	.09
	100.35	99.21	100.10	100.18	100.26	100.03
Less O	.03		.19	.04	.11	.04
	100.32		99.91	100.14	100.15	99.99

a Including ZrO_2.

G. Syenite-porphyry. Contains orthoclase, plagioclase, microperthite, hornblende, quartz, augite, magnetite, biotite, apatite, and zircon.

H. Granite-porphyry. Composition like D, but with more quartz.

I. Basic segregation in H. Contains hornblende, green and brown augite, biotite, quartz, microperthite, magnetite, little apatite, and zircon.

J. Diorite. Contains hornblende, augite, biotite, plagioclase, titaniferous magnetite, sphene, zircon, and quartz.

K. Diorite. Composition like J.

L. Another sample of K.

	G.	H.	I.	J.	K.	L.
SiO_2	64.88	73.69	56.53	52.12	57.97	64.62
Al_2O_3	16.24	12.46	16.47	16.35	*a*17.28	16.46
Fe_2O_3	1.37	1.21	1.58	3.68	2.23	1.82
FeO	2.70	1.75	5.40	6.02	3.75	2.14
MgO	.89	.17	2.67	4.14	2.20	1.10
CaO	1.92	.36	4.90	7.25	4.33	2.39
Na_2O	5.00	4.47	5.59	3.65	4.31	4.57
K_2O	5.61	4.92	3.80	2.34	4.12	5.21
H_2O at 110°	.19	.14	.23	.25	.18	.13
H_2O above 110°	.46	.24	.60	.88	.57	.39
TiO_2	.69	.28	1.40	2.10	1.54	.81
P_2O_5	.13	.04	.27	.89	.64	.21
ZrO_2	.13	.14	.03	.02	....	.03
MnO	.14	.15	.20	.17	.15	.12
(NiCo)O	none	none	trace	trace	trace	none
BaO	.06	none	trace	.04	.07?	.03
CO_2	none	trace	.05	.07	.05	.11
F	.08	.05	.19	.03	.04	undet.
Cl	.04	.02	.07	.09	undet.	.05
FeS_2	none	none	trace	.24	.32	.19
	100.53	100.09	99.98	100.33	99.75	100.38
Less O	.04	.02	.09	.03	.02	.01
	100.49	100.07	99.89	100.30	99.73	100.37

a Including ZrO_2.

M. Basic segregation in diorite. Contains hornblende, augite, biotite, plagioclase, magnetite, apatite, zircon, and a little quartz.

N. Diabase. Contains plagioclase, augite, and magnetite.

O. Camptonite. Contains brown hornblende, plagioclase, a little augite, olivine, magnetite, and apatite.

P. Phyllite. Contains quartz, sericite, graphite?, magnetite, pyrite, rare orthoclase, plagioclase, sphene, and rutile.

Q. Microperthite-hornfels. Contains biotite, quartz, red garnet, corundum, magnetite, iolite, microperthite, and rarely pleonaste.

R. Cordierite-hornfels. Contains quartz, biotite, pleonaste, corundum, iolite, magnetite, plagioclase, red garnet, and epidote?.

	M.	N.	O.	P.	Q.	R.
SiO_2	55.28	49.63	48.22	90.91	58.35	45.30
Al_2O_3	17.23	14.40	14.27	4.18	21.30	30.51
Fe_2O_3	1.54	2.85	2.46	.22	.03	.24
FeO	6.23	8.06	9.00	1.27	6.41	8.80
MgO	2.69	7.25	6.24	.37	2.10	3.11
CaO	5.60	9.28	8.45	.22	.85	.90
Na_2O	5.42	2.47	2.90	.77	1.60	1.65
K_2O	2.12	.70	1.93	.58	5.63	4.84
H_2O at 110°	.20	.27	.28	.06	.31	.26
H_2O above 110°	.71	1.47	1.66	.74	.86	1.05
TiO_2	1.64	1.68	2.79	.28	.87	1.48
P_2O_5	.73	.25	.64	.05	.18	.12
ZrO_2	trace	trace?	.03	.02	none	none
MnO	.24	.17	.20	trace	.13	.20
(NiCo) O	(?)	.04	.03	none	.03	.02
BaO	.06	trace?	.04	trace	.05	.03
CO_2	.04	1.36	.15	.18		
C				.10	.40	.17
SO_3	none	none	none	none	none	.04
Cl	.07	.07	.10		.03	.04
F	.28	trace	.05	trace	(?)	.04
FeS_2	.07	.22	.36	.11	.58	1.07
	100.15	100.17	99.80	100.06	99.71	99.87
Less O	.13	.02	.04			
	100.02	100.15	99.76			

In these rocks the sulphur is all reckoned as pyrite, although pyrrhotite also is probably present. The carbonic acid represents either dolomite or siderite; not calcite. Traces of lithia and strontia occur in nearly all. Samples H, L, O, and Q contain traces of copper. In N there is 0.03 V_2O_3, a supplementary determination by Hillebrand.

2. MISCELLANEOUS ROCKS.

A. Amphibolite, Guilford. Described by Emerson in Mon. XXIX. Contains hornblende needles, with albite and rutile. Analysis by L. G. Eakins, record No. 1326.

B. Granitoid gneiss, north of Lincoln's.

C. The same, west slope of Little Peco.

D. Chloritic granite, East Clarendon section.

E. Hornblende-granite, East Clarendon section.

Rocks B, C, D, and E collected by C. L. Whittle, but not described. Analyses by H. N. Stokes, record No. 1396.

	A.	B.	C.	D.	E.
SiO_2	49.16	71.02	69.97	67.33	52.60
Al_2O_3	16.43	15.00	14.90	16.20	18.45
Fe_2O_3	3.92	1.12	2.16	1.40	2.47
FeO	7.19	1.81	.96	2.73	6.11
MgO	8.19	.69	.37	1.31	4.22
CaO	9.21	.31	.45	2.81	7.55
Na_2O	3.70	2.48	2.85	3.15	3.24
K_2O	.41	5.79	6.54	2.14	1.12
H_2O	.45	1.14	.66	1.84	2.53
TiO_2	1.03	.35	.44	.80	1.11
P_2O_5	.16	.13	.12	.16	.20
Cr_2O_3	trace	....	....	....	....
MnO	.23	trace	trace	trace	.23
BaO	.02	trace	.09	.05	....
	100.10	99.84	99.51	99.92	99.83

MASSACHUSETTS.

1. ROCKS OF THE CONNECTICUT VALLEY.

Described by Emerson in Mon. XXIX.

A. Serpentine derived from salite, Osburn's soapstone quarry, Blandford.

B. Dark-green, oily serpentine, center of large Middlefield bed.

C. Enstatite, slightly altered, from Granville. For comparison with D.

D. Serpentine derived from enstatite, Granville.

Analyses A, B, and C by W. F. Hillebrand, record No. 1555. Analysis D by Geo. Steiger, No. 1536.

	A.	B.	C.	D.
SiO_2	40.77	38.62	54.04	37.82
Al_2O_3	1.16	.35	.52	.61
Fe_2O_3	3.56	3.44	1.51	7.92
FeO	1.47	3.99	3.90	1.15
MgO	39.37	40.61	34.40	37.94
CaO	none	.40	none	none
Na_2O	.14	.10	.08	trace
K_2O	.10	.08		
H_2O at 110°	.49	.36	.70	.75
H_2O above 110°	12.48	10.91	3.07	12.50
TiO_2	none	none	none	trace
P_2O_5	trace	trace	none	trace
Cr_2O_3	.28	.39	.14	.19
MnO	.09	.10	.11	....
NiO	.17	.21	.23	.45
CoO	....	....	....	.05
Li_2O	trace	trace	....	....
CO_2	none	.52	1.32	....
	100.08	100.08	100.02	99.38

E. Rich, dark-green serpentine, Rowe.

F. Black serpentine containing marmolite, Atwater's quarry, Russell.

G. Blackish-green serpentine containing much chromite. From "The Crater," North Blandford.

H. Gray, splintery serpentine, Chester.

Analyses by Steiger, record No. 1536.

	E.	F.	G.	H.
SiO_2	40.42	36.94	39.14	33.87
Al_2O_3	1.86	.50	1.18	.77
Fe_2O_3	2.75	6.04	4.46	2.81
FeO	4.27	1.94	3.14	4.25
MgO	35.95	38.35	41.45	38.57
CaO	.66	none	none	none
Na_2O, K_2O	.16	none	none	none
H_2O at 100°	.21	.71	.34	.38
H_2O above 100°	10.51	12.07	9.48	7.00
TiO_2	none	trace	none	none
P_2O_5	trace	trace	.02	trace
Cr_2O_3	.28	.33	.33	.38
MnO	trace	trace	none	.04
NiO, CoO	.53	.40	.47	.33
CoO	trace	none	trace	
CO_2	1.44	1.85	none	10.82
SO_3	trace	.20	none	.20
FeS_2	.43			
	99.47	99.33	100.01	99.42

I. Peridotite, Belchertown. Contains hornblende, pyroxene, biotite, olivine, and magnetite. Analysis by L. G. Eakins, record No. 1326.

J. Massive, coarse, altered diabase, Leverett. Contains saussuritic feldspar with black hornblende. Analysis by Eakins, record No. 1325.

K. Tonalite, South Leverett. Dark green, chloritic. Contains reddish feldspar, dark hornblende, and a network of dark-green epidotic quartz veins. Analysis by Eakins, record No. 1326.

L. Biotite-granite, Moore's quarry, Florence. Very feldspathic. Quartz rare, with fluid inclusions. Feldspar mostly triclinic, orthoclase and microcline present in small quantities. Little muscovite, some rutile. Analysis by Eakins, record No. 1414.

	I.	J.	K.	L.
SiO_2	48.63	51.56	55.51	73.27
Al_2O_3	5.32	14.82	16.51	15.51
Fe_2O_3	2.91	4.30	1.68	.33
FeO	3.90	7.21	4.57	1.14
MgO	21.79	7.36	6.73	.15
CaO	13.04	7.09	6.73	2.74
Na_2O	.34	4.21	3.19	4.79
K_2O	.23	.17	2.46	1.66
H_2O	2.81	1.47	1.53	.68
TiO_2	.47	1.97	.91	.10
P_2O_5	.21	.09	.17	trace
Cr_2O_3	.36	----------	----------	----------
MnO	.12	trace	.11	trace
BaO	trace	trace	.02	----------
CO_2	trace	----------	----------	----------
	100.13	100.25	100.12	100.37

M. Amphibolite, Bernardston. A black, heavy, massive hornblende rock. Analysis by L. G. Eakins, record No. 1327.

N. Porphyritic amphibolite, Heath. Analysis by Eakins, record No. 1325.

O. Amphibolite, New Salem. Analysis by Eakins, record No. 1325.

P. Amphibolite, Whitmans Ferry, Sunderland. Thin, shaly, aphanitic. Analysis by Eakins, record No. 1325.

	M.	N.	O.	P.
SiO_2	51.72	51.38	45.48	49.86
Al_2O_3	16.51	18.01	19.43	15.50
Fe_2O_3	1.72	3.30	.13	2.99
FeO	9.56	8.53	6.58	8.01
MgO	6.58	5.08	11.08	7.79
CaO	8.89	6.27	10.66	8.89
Na_2O	2.74	5.34	2.28	3.26
K_2O	.34	.18	.11	.72
H_2O	.51	.56	3.17	1.51
TiO_2	1.39	1.07	.77	1.58
P_2O_5	.23	.18	.14	.11
Cr_2O_3	....	....	trace	....
MnO	trace	.19	trace	.07
BaO	trace	trace	.01	trace
CO_2	....	....	.20	....
	100.19	100.09	100.04	100.29

Q. Amphibolite. South Leverett. Deep green, ligniform. Analysis by L. G. Eakins, record No. 1327.

R. Amphibolite, Goshen. Derived from Conway limestone. Analysis by Eakins, record No. 1414.

S. Black, fissile amphibolite, Worthington. Nearly pure, matted hornblende. Titanite and sometimes zircon present. Analysis by Eakins, record No. 1326.

T. Black, fissile, porphyritic amphibolite, Warwick. Analysis by Eakins, record No. 1414. Collected by Emerson, but not described in Monograph XXIX.

	Q.	R.	S.	T.
SiO_2	47.56	55.64	48.53	50.65
Al_2O_3	16.13	16.27	16.35	13.03
Fe_2O_3	1.80	1.22	2.03	.27
FeO	9.39	7.20	10.52	12.67
MgO	9.21	5.58	9.71	16.96
CaO	6.67	9.23	9.83	1.73
Na_2O	2.52	.91	1.36	1.37
K_2O	1.58	.19	.32	.04
H_2O	3.51	3.11	.79	2.96
TiO_2	1.24	.50	.51	.50
P_2O_5	.21	.23	.07	trace
Cr_2O_3	trace	....	....	trace
MnO	.08	.28	.17	.15
BaO	trace	....	trace	....
	99.90	100.36	100.19	100.33

2. MISCELLANEOUS ROCKS.

Collected by B. K. Emerson and unpublished at the date of writing.

A. Wehrlite, New Braintree. Contains diallage, enstatite, augite, anorthite, biotite, apatite, chromite, magnetite, and pyrrhotite. Analysis by L. G. Eakins, record No. 1327

B. Black, serpentinized boltonite, Stow. Analysis by W. F. Hillebrand, record No. 1555.

C. Highly metamorphosed feldspathic conglomerate, graduating into arkose-gneiss, electric railroad cut, Marlboro. Analysis by George Steiger, record No. 1536.

D. Phonolite, Southboro. No description furnished. Analysis by H. N. Stokes, record No. 1653. Contains traces of chlorine and fluorine; 63.2 per cent of the rock is decomposable by hydrochloric acid.

	A.	B.	C.	D.
SiO_2	50.64	36.92	75.35	54.22
Al_2O_3	7.93	.10	13.03	20.20
Fe_2O_3	1.41	1.19	.62	2.35
FeO	14.82	.87	.94	1.02
MgO	18.58	43.99	.21	.29
CaO	3.41	.59	1.33	.70
Na_2O	.96	.05	2.44	9.44
K_2O	.21		5.14	4.85
H_2O at 100°	.87	.72	.15	.42
H_2O above 100°		14.70	.73	5.57
TiO_2	.82	none	.21	.38
P_2O_5	.27	trace	.08	.11
Cr_2O_3	.05	none	....	none
MnO	.16	trace	none	.19
BaO	....	none	.07	trace
CO_2	....	.90	.03	trace
SO_3	....	....	.03	none
	100.13	100.03	100.36	99.74

Keratophyr, Marblehead Neck. Described by Sears, in Bull. Museum Compar. Zoölogy, vol. 16, No. 9, p. 170. Contains crystals of feldspar, with a decomposed base, irregular patches of quartz, some scales of biotite and grains of magnetite, and also some limonite and earthy matter. The feldspar is anorthoclase. Analyses by T. M. Chatard, record No. 1176.

A. The rock.
B. The separated feldspar.

	A.	B.
SiO_2	70.23	65.66
Al_2O_3	15.00	20.05
Fe_2O_3	1.99	trace
FeO	undet.	trace
MgO	.38	.18
CaO	.33	.67
Na_2O	4.98	6.56
K_2O	4.99	6.98
H_2O at 110°	.91	.04
H_2O at redness	1.28	.37
TiO_2?	.03	undet.
P_2O_5	.06	undet.
MnO	.24	.13
	100.42	100.64

Feldspars from schists of Berkshire County. Described by Wolff, Mon. XXIII, pp. 60 and 187. All albite. Analyses by R. B. Riggs, record Nos. 507 and 567.

A. From feldspathic schist, central shaft of the Hoosac tunnel. P. R. C. 129.

B, C. From the porphyritic mica-schist of Greylock Mountain.

	A.	B.	C.
SiO_2	69.69	68.08	67.83
Al_2O_3, Fe_2O_3	18.60	20.11	19.92
MgO	.20	(?)	(?)
CaO	trace	trace	trace
Na_2O	10.28	11.00	11.65
K_2O	.40	.36	.25
Ignition	.42	.31	.12
MnO	....	trace	trace
	99.59	99.86	99.77

Fe_2O_3 less than 0.5 in any case.

CONNECTICUT.

A. Olivine-basalt, main flow, Pine Hill, South Britain. Contains plagioclase, pink augite, olivine, and magnetite. The rock is quite fresh.

B. Olivine-basalt, anterior flow, South Britain. Contains plagioclase, uralitized augite, olivine, and magnetite. Rock much altered and containing numerous amygdules of calcite and prehnite, stained by iron.

Rocks A and B studied by W. H. Hobbs, who furnishes the petrographic data. Hitherto unpublished. Analyses by W. F. Hillebrand, record No. 1842.

C. Basic pitchstone (tachylyte), from the so-called "ash-bed" northeast of Meriden. Described by Emerson in Bull. Geol. Soc. Amer., vol. 8, p. 77. Analysis by H. N. Stokes, record No. 1641.

	A.	B.	C.
SiO_2	52.40	47.52	46.86
Al_2O_3	13.55	13.91	13.96
Fe_2O_3	2.73	7.06	5.23
FeO	9.79	3.76	4.67
MgO	5.53	6.84	7.69
CaO	10.01	5.71	9.42
Na_2O	2.32	3.06	1.85
K_2O	.40	.77	2.02
H_2O at 105°	.62	1.75	1.29
H_2O above 105°	1.05	4.55	3.43
TiO_2	1.08	1.19	1.13
P_2O_5	.12	.15	.15
NiO	trace	trace	
MnO	.26	.18	trace
SrO	none	none	trace
BaO	trace?	trace	.03
Li_2O	none	trace	trace
CO_2		3.68	2.19
F			trace
FeS_2 or Fe_7S_8 *a*	.13		
	99.99	100.13	99.92

a Calculated as pyrite.

NEW YORK.

I. ROCKS OF THE ADIRONDACK REGION.

Collected by J. F. Kemp, who furnishes the petrographic data. A and G are described by Kemp in 19th Ann., Part III, p. 383. The other descriptions are hitherto unpublished. Analyses A and B by George Steiger, record No. 1715; C to G by W. F. Hillebrand, record No. 1717.

A. Wall rock of iron mine near Lincoln Pond, Elizabethtown. Varies from norite to gabbro. Chief minerals, green augite, hypersthene, brown hornblende, plagioclase, and magnetite. Microperthitic feldspar less common. Garnet varies from absence to abundance.

B. Coarse gabbro, top of Whiteface Mountain. A pyroxenic phase of the anorthosite. Contains much labradorite, abundant light-green augite, brown hornblende, shreds of more or less bleached brown biotite, and magnetite.

	A.	B.
SiO_2	44.77	53.18
Al_2O_3	12.46	23.25
Fe_2O_3	4.63	1.53
FeO	12.99	1.82
MgO	5.34	2.60
CaO	10.20	11.18
Na_2O	2.47	3.97
K_2O	.95	.86
H_2O at 100°	.12	.15
H_2O above 100°	.48	.98
TiO_2	5.26	.45
P_2O_5	.28	.09
NiO, CoO	trace?	(?)
MnO	.17	.11
BaO	trace?	trace?
CO_2	.37	.34
S	*a* .26	trace
	100.75	100.51

a Mainly present as pyrrhotite.

C. Pyroxenic anorthosite, Elizabethtown. Contains largely labradorite, subordinate light-green augite, less brown hornblende, and a little magnetite.

D. Norite, with close affinity to gabbro. Intrusion in C. Contains labradorite, hypersthene, garnets, green augite, brown hornblende, a little brown biotite, magnetite, and apatite.

E. Diabasic norite or gabbro, Elizabethtown. Contains the same minerals as D.

F. Gneissoid derivative, by pressure, of E. The same minerals, but with hornblende more abundant.

G. Gabbro, wall rock of Split Rock mine. Contains augite, hypersthene, brown hornblende, garnet, plagioclase, magnetite, and possibly spinel.

	C.	D.	E.	F.	G.
SiO_2	56.94	47.16	44.97	46.74	47.88
Al_2O_3	20.82	14.45	15.38	16.63	18.90
Fe_2O_3	.83	1.61	2.29	2.17	1.39
FeO	3.02	13.81	12.39	10.60	10.45
MgO	2.36	5.24	10.89	6.11	7.10
CaO	9.41	8.13	7.50	8.66	8.36
Na_2O	3.36	3.09	3.02	3.81	2.75
K_2O	1.58	1.20	.56	.86	.81
H_2O at 110°	.21	.12	.10	.12	.18
H_2O above 110°	.59	.48	.65	.73	.43
TiO_2	.44	3.37	1.18	2.54	1.20
P_2O_5	.07	.57	.14	.33	.20
V_2O_3	(?)	(?)	.02	(?)	(?)
NiO, CoO	trace	.02	.02	.03	.02
MnO	.11	.24	.22	.26	.16
BaO	.05	trace	trace	trace	trace
CO_2	.45	.35	.23	.07	.12
S	trace	.14	.06	.11	.07
	100.24	99.98	99.64	99.77	100.02

ZrO_2, Cl, and F not looked for. Cr_2O_3, Li_2O, and SrO present in traces. S is in part, at least, present as pyrrhotite.

2. PERIDOTITE FROM DEWITT, NEAR SYRACUSE.

A rock described by Darton and Kemp, Amer. Journ. Sci., 3d series, vol. 49, p. 456. Contains olivine, partly serpentinized, biotite, and augite, with magnetite, apatite, and perofskite. Possibly a little chromite also. Classed by Kemp as limburgite.

Analysis by H. N. Stokes, record No. 1491. The FeO represents the total iron, because the sulphides present, possibly as pyrrhotite, prevent the separate estimation of the two iron oxides.

SiO_2	36.80	NiO	.09
Al_2O_3	4.16	MnO	.13
FeO	8.33	BaO	.12
MgO	25.98	SrO	trace
CaO	8.63	CO_2	2.95
Na_2O	.17	SO_3	.06
K_2O	2.48	S	.95
H_2O below 100°	.51		
H_2O above 100°	6.93		100.22
TiO_2	1.26	O=S	.47
P_2O_5	.47		99.75
Cr_2O_3	.20		

NEW JERSEY.

Rocks A, B, and C, described by J. P. Iddings in Bull. 150, pp. 254, 209, 236. Analyses by Eakins, record No. 1299.

A. Basalt, Watchung Mountain, Orange. Contains pyroxene, mostly malacolite, plagioclase, magnetite, and glass, with variable amounts of serpentine or chlorite. The feldspar is partly altered into a mineral which is probably prehnite. P. R. C. 102.

B. Elæolite-syenite, Beemersville. Contains nephelite, orthoclase, ægirite, and biotite, with melanite, sphene, apatite, zircon, and magnetite in smaller amounts. Sodalite is probably present also. P. R. C. 78.

C. Minette, Franklin Furnace. Contains alkali-feldspar, biotite, monoclinic pyroxene, magnetite, epidote, calcite, chlorite, apatite, sphene, pyrite, and a little secondary quartz. P. R. C. 91.

D. Nepheline-syenite, Brookville. Collected by N. H. Darton and described by F. L. Ransome in Amer. Journ. Sci., 4th series, vol. 8, p. 417. Contains alkali-feldspars, nepheline largely altered to secondary minerals, brown amphibole, biotite, cancrinite, plagioclase, muscovite, ægirine-augite, apatite, titanite, fluorite, and a few specks of magnetite. Also secondary analcite, sericite, and natrolite (?). Analysis by Steiger, record No. 1807.

	A.	B.	C.	D.
SiO_2	51.36	53.56	40.71	54.68
Al_2O_3	16.25	24.43	19.46	21.63
Fe_2O_3	2.14	2.19	7.46	2.22
FeO	8.24	1.22	6.83	2.00
MgO	7.97	.31	6.21	1.25
CaO	10.27	1.24	11.83	2.86
Na_2O	1.54	6.48	1.80	7.03
K_2O	1.06	9.50	3.26	4.58
H_2O at 100°	1.33	.93	1.53	.27
H_2O above 100°				1.88
TiO_2				.79
P_2O_5				.28
MnO	.09	.10	.18	trace
NiO	.03			
BaO				.05
F				.22
SO_3				.07
CO_2			.74	none
	100.28	99.96	100.01	99.81
Less O=F				.09
				99.72

PENNSYLVANIA.

A. Aporhyolite, Monterey, Franklin County. Described by Florence Bascom in Bull. 150, p. 343. Contains alkali feldspars, quartz, sericite, epidote, titaniferous magnetite, leucoxene, and rarely sphene. Analysis by H. N. Stokes, record No. 1479. P. R. C. 136.

B. Quartz-porphyry, same locality. Analyzed for G. H. Williams, but never described. Analysis by L. G. Eakins, record No. 1350

	A.	B.
SiO_2	76.34	73.85
Al_2O_3	11.60	13.15
Fe_2O_3	2.41	3.27
FeO	.30	.36
MgO	.06	.32
CaO	.55	.82
Na_2O	5.50	2.29
K_2O	2.75	5.42
H_2O at 100°	.10	.71
H_2O above 100°	.39	
TiO_2	.26	....
P_2O_5	trace	.06
MnO	trace	.09
BaO	.09	....
CO_2	trace	....
	100.35	100.34

DELAWARE.

Feldspars from gabbros. Separated by Diller, described by Chester in Bull. 59. Analyses by R. B. Riggs, record Nos. 459, 460, 461.

A. Sp. gr. 2.592 to 2.877, from a typical gabbro, Brandywine Creek, Wilmington.

B. Sp. gr. 2.592 to 2.780, from a typical hypersthene-gabbro, Fifth and Van Buren streets, Wilmington.

C. Sp. gr. 2.592 to 2.749, from "Iron Hill hyperite changing to diorite," near Whitaker's ore pit.

	A.	B.	C.
SiO_2	70.37	51.44	44.09
Al_2O_3	18.36	30.05	35.41
Fe_2O_3	.58	.96	.51
MgO	.04	trace	none
CaO	5.08	13.19	18.47
Na_2O	4.32	4.07	.99
K_2O	.63	.21	.19
MnO	trace	....	trace
Ign	.45	.35	.35
	99.83	100.27	100.01

Samples dried at 105°. FeO not determined separately.

MARYLAND, INCLUDING THE DISTRICT OF COLUMBIA.

1. PERIDOTITE AND PYROXENITE.

Rocks A to I, inclusive, described by G. H. Williams in Amer. Geologist, vol. 6, p. 35.

A. Porphyritic lherzolite, Johnny Cake Road, Baltimore County. Contains olivine, bronzite, and diallage, the olivine partly serpentinized. Analysis by T. M. Chatard, record No. 1094.

B. Pyroxenite, Johnny Cake Road. Consists entirely of hypersthene and diallage. P. R. C. 110.

C, D. Alterations of B. B, C, and D dried at 104°.

E. Smaragdite rock, altered pyroxenite, Dogwood Road, Baltimore County.

Analyses B, C, D, and E by J. E. Whitfield, record Nos. 975, 976. C, D, and E are from the laboratory record, and do not appear in the published paper.

	A.	B.	C.	D.	E.
SiO_2	43.87	50.80	50.10	51.94	53.22
Al_2O_3	1.64	3.40	2.00	2.53	3.14
Fe_2O_3	8.94	1.39	2.38	2.88	....
FeO	2.60	8.11	8.68	9.38	7.95
MgO	27.32	22.77	26.85	25.97	20.09
CaO	6.29	12.31	5.06	3.60	14.44
Na_2O, K_2O	.50	trace	none	none	trace
H_2O at 110°	1.08	.52	4.16	2.82	.98
H_2O at red heat	7.64				
TiO_2	.12	none	none	none	none
P_2O_5	trace	trace	none	none	....
Cr_2O_3	.44	.32	.36	.60	.23
NiO	trace	....	....	....	....
MnO	.19	.17	.29	trace	.11
SO_3	....	trace	trace	.19	trace
Cl	....	.24	.26	.16	.26
	100.63	100.03	100.14	100.07	100.42

F, G. Two samples of websterite, Hebbville, 6 miles west of Baltimore.

H. Bronzite from G.

I. Diopside from G.

The rock consists entirely of bronzite and diopside. Analyses by T. M. Chatard, record Nos. 1094, 1123.

J. Websterite, Oakwood, Cecil County. Composed of hypersthene and diallage. Analysis by W. F. Hillebrand, record No. 1755. Described by A. G. Leonard, but hitherto unpublished.

K. Cortlandtite, Ilchester, Howard County. Analysis by W. F. Hillebrand, record No. 1422. Published by Williams in Fifteenth Ann., page 674. The rock consists of olivine, pyroxene, and large hornblende crystals, the latter considerably altered to talc.

	F.	G.	H.	I.	J.	K.
SiO_2	53.98	52.55	54.53	51.80	53.21	39.20
Al_2O_3	1.32	2.71	1.93	2.21	1.94	4.60
Fe_2O_3	1.41	1.27	1.70	1.29	1.44	3.45
FeO	3.90	4.90	8.92	3.50	7.92	6.15
MgO	22.59	20.39	29.51	17.76	20.78	31.65
CaO	15.47	16.52	2.25	20.99	13.12	3.23
Na_2O	undet.	.27		undet.	.11	.42
K_2O	undet.			undet.	.07	.14
H_2O at 100°	.09	1.09	1.14	.65	.14	.50
H_2O above 100°	.83				.87	9.38
TiO_2	.15	.14	undet.	.13	.26	.52
P_2O_5	trace	trace	trace	trace	trace	trace
ZrO_2					trace	
V_2O_3					.03	
Cr_2O_3	.53	.44	.30	.51	.20	.41
NiO	trace				.03	.30
CoO						
MnO	.21	.24	.28	trace	.22	.20
SrO					none	
BaO					none	
Li_2O					trace	trace
FeS_2					.03	
CO_2					.10	
	100.48	100.52	100.56	98.84	100.47	100.15

2. GABBRO AND DIORITE.

Rocks A to E, inclusive, described by G. H. Williams, but not in detail, in 15th Ann., pp. 673, 674. Some of the rocks, with other analyses, are discussed by him in Bull. 28. Analyses by W. F. Hillebrand, record No. 1422.

A. Olivine-gabbro, Orange Grove, Baltimore County. Contains plagioclase, diallage, hypersthene, fresh olivine, magnetite, and apatite, and sometimes hornblende.

B. Hypersthene-gabbro, Wetheredville, Baltimore County. Rich in hypersthene and diallage, with plagioclase, magnetite, and apatite.

C. Gabbro-diorite, Ilchester, Howard County. A coarse anorthite-hornblende rock, probably an altered gabbro.

D. Biotite-diorite, Triadelphia, Montgomery County.

E. Biotite-diorite, Georgetown, D. C.

To these may be added an apparently unpublished analysis made for Williams by L. G. Eakins, record No. 1350, as follows:

F. Hornblende-diorite, Rock Creek tunnel shaft, Washington, D. C. Relations to E not stated.

	A.	B.	C.	D.	E.	F.
SiO_2	48.91	44.76	43.42	55.97	56.41	56.18
Al_2O_3	8.81	18.82	22.37	15.60	15.19	14.76
Fe_2O_3	1.04	2.19	.81	1.21	1.60	2.12
FeO	9.52	4.73	9.25	6.28	6.24	6.98
MgO	15.19	11.32	5.75	6.83	7.18	8.11
CaO	14.69	14.58	13.34	7.31	6.77	7.97
Na_2O	.64	.89	1.24	2.23	2.21	1.62
K_2O	.10	.11	1.13	1.25	1.34	.80
H_2O at 100°	.07	.17	.09	.18	.08	1.37
H_2O above 100°	.52	2.36	1.54	1.85	2.00	
TiO_2	.37	.13	1.25	1.11	.69	....
P_2O_5	trace	none	.10	.16	.05	.08
SnO_2, ZrO_2?	....	....	....	....	.14	....
Cr_2O_3	.15	.08	trace	.04	.05	....
MnO	.16	.15	.06	.08	.11	.17
Li_2O	trace	trace	trace	trace	trace	....
	100.17	100.29	100.35	100.10	100.06	100.16

The following rocks, from Cecil County, have been studied by A. G. Leonard. Descriptions as yet unpublished.

G. Quartz-biotite-hornblende-diorite, near the foundry on Stone Run. Granitic in appearance.

H. Quartz-biotite-hornblende-diorite, near Porter's bridge on Octoraro Creek.

I. A true diorite with very little quartz, Stone Run, one-half mile northwest of the mill near Rising Sun.

J. Norite, three-fourths of a mile northwest of McKinsey's mill.

Analyses by Hillebrand, record No. 1755.

	G.	H.	I.	J.
SiO_2	58.57	55.16	44.04	48.02
Al_2O_3	16.10	17.51	20.01	20.01
Fe_2O_3	2.89	2.62	4.22	1.13
FeO	6.12	5.83	8.61	7.29
MgO	2.33	4.35	5.01	10.05
CaO	7.39	8.50	11.68	11.42
Na_2O	2.11	1.83	1.24	.51
K_2O	1.01	1.08	.15	.05
H_2O at 105°	.21	.18	.11	.10
H_2O above 105°	1.27	2.01	1.90	.57
TiO_2	1.41	.64	2.24	.23
P_2O_5	.37	.21	.52	trace
ZrO_2	.09	.02	.10	none
V_2O_3	.02	.04	.05	.02
Cr_2O_3	none	trace	none	.03
NiO, CoO	none	.01	.01	.01
MnO	.18	.15	.28	.18
SrO	trace	trace	none	none
BaO	trace	trace	none	none
Li_2O	trace	trace	trace	trace
FeS_2	trace	.03	.25	.11
CO_2	none	none	none	.25
	100.07	100.17	100.42	99.98

3. GRANITE AND GNEISS.

For descriptions see Williams, 15th Ann., p. 657, and Keyes, *ibid.*, p. 685. The Rowlandsville granite is described by Grimsley in Journ. Cincinnati Soc. Nat. Hist., vol. 17, p. 78.

A. White granite, Brookville, Montgomery County. (Williams.)

B. Binary granite, Guilford, Howard County. Contains quartz, orthoclase, a little plagioclase, muscovite, and biotite, with occasional zircon and apatite. (Keyes.)

C. Biotite-granite, Woodstock. Light colored, fine grained. Quartz, feldspar, and biotite, with accessory allanite and epidote. (Keyes.)

D. Biotite-granite, Rowlandsville, Cecil County. Dark colored. Contains plagioclase, orthoclase, quartz, epidote, biotite, sphene, magnetite, and apatite, with a little secondary muscovite. The percentages of the several minerals are computed by Grimsley from the analysis.

Analyses by W. F. Hillebrand, record Nos. 1220, 1422, 1455. In B and C manganese was present, barium and strontium were not tested for, and the alumina contains possible titanium and phosphoric acid.

	A.	B.	C.	D.
SiO_2	74.87	72.57	71.79	66.68
Al_2O_3	14.27	15.11	15.00	14.93
Fe_2O_3	trace	.59	.77	1.58
FeO	.51	1.02	1.12	3.32
MgO	.16	.30	.51	2.19
CaO	.48	1.65	2.50	4.89
Na_2O	3.06	3.92	3.09	2.65
K_2O	5.36	4.33	4.75	2.05
H_2O at 100°	.26	.47	.64	.16
H_2O above 100°	.66			1.09
TiO_2	.05	undet.	undet.	.50
P_2O_5	.21	undet.	undet.	.10
MnO	trace	undet.	undet.	.10
SrO	....	undet.	undet.	trace
BaO	....	undet.	undet.	.08
Li_2O	trace	trace	trace	trace
	99.89	99.96	100.17	100.32

E. Biotite-granite, Dorseys Run, Howard County. Typical, dark colored. Quartz, feldspar, and biotite, with accessory allanite and epidote. (Keyes.)

F. Same locality, light-colored dikes.

G. Inclusions in E. Derived from gneiss.

H. The typical gneiss of the Dorseys Run area. Perhaps of sedimentary origin.

Descriptions by Keyes. Analyses by Hillebrand. The remarks appertaining to B and C apply here also. Record No. 1220.

	E.	F.	G.	H.
SiO_2	62.91	70.45	57.33	48.92
Al_2O_3	19.13	15.98	15.31	16.57
Fe_2O_3	.98	.75	3.39	4.21
FeO	3.20	1.84	8.19	9.18
MgO	1.69	.77	4.36	5.98
CaO	4.28	2.60	3.95	9.69
Na_2O	3.94	3.83	1.22	2.47
K_2O	3.38	3.59	4.57	1.56
H_2O	.63	.45	1.80	1.68
Li_2O	trace	trace	trace	trace
	100.14	100.26	100.12	100.26

I. Biotite-granite, Sykesville. Contains quartz, feldspar, and biotite, with accessory magnetite, zircon, and apatite.

J. Inclusion in I, derived from limestone. Yellowish central portion. Consists of epidote and quartz, with a little chlorite.

K. Same inclusion, fine-grained dark outer zone. Quartz, garnet, and epidote, with a little magnetite. Feldspar and muscovite in some portions. Descriptions by Keyes. Analyses by Hillebrand, record No. 1220, with the same limitations as in the Guilford, Woodstock, and Dorseys Run granites.

	I.	J.	K.
SiO_2	71.45	67.02	47.35
Al_2O_3	14.36	13.77	29.76
Fe_2O_3	2.07	4.64	2.94
FeO	2.78	1.02	3.15
MgO	1.17	.65	1.60
CaO	1.58	11.09	2.20
Na_2O	1.95	.66	2.84
K_2O	3.28	.09	6.83
H_2O	1.30	1.16	3.15
Li_2O	trace	trace	trace
	99.94	100.10	99.82

L. Typical gneiss of Washington, D. C., from quarry of Potomac Stone Company, 1 mile below Chain Bridge. A basic granite.

M. Fine-grained, fissile, chloritic gneiss, from northwest of Cabin John Bridge. Also a basic granite.

N. Fine-grained, hard gneiss, from the second lock at the Great Falls of the Potomac. Probably of sedimentary origin.

Described by Williams. Analyses by Hillebrand, record No. 1459.

	L.	M.	N.
SiO_2	67.22	63.43	78.28
Al_2O_3	15.34	16.69	9.96
Fe_2O_3	2.78	3.36	1.85
FeO	3.41	3.87	1.78
MgO	1.65	2.33	.95
CaO	1.36	.80	1.68
Na_2O	2.00	2.38	2.73
K_2O	3.26	3.22	1.35
H_2O at 110°	.29	.23	.12
H_2O above 110°	1.68	2.67	.83
TiO_2	.84	.91	.70
P_2O_5	.14	.11	.11
MnO	.13	.09	.08
SrO	trace	trace	trace
BaO	.04	.03	.02
Li_2O	trace	trace	trace
	100.14	100.12	100.44

To these may be added three analyses of feldspars from the pegmatite of Jones Falls, Baltimore. Described by S. L. Powell in Johns Hopkins Univ. Circular, vol. 12, p. 49. Analyses by W. F. Hillebrand, record No. 1421.

O. Flesh-colored microcline.

P. Green microcline.

Q. Albite-oligoclase, near Ab_4An.

	O.	P.	Q.
SiO_2	65.06	68.48	63.72
Al_2O_3	18.41	16.11	22.26
Fe_2O_3	trace	.20	trace
FeO		.17	
MgO	.04	.03	.06
CaO	.26	.23	3.58
Na_2O	1.60	1.27	8.98
K_2O	14.30	12.99	.76
H_2O at 100°	.04	.06	.09
H_2O above 100°	.26	.26	.43
SrO	trace	trace	trace
BaO	.13	.05	....
	100.10	99.85	99.88

P contained a little unseparated quartz. All three contained traces of lithia. In O and Q the traces of iron were weighed with the alumina.

4. MISCELLANEOUS ROCKS.

A. Typical diabase, Rocky Ridge. Analyzed for J. S. Diller, but not described. Analysis by E. A. Schneider, record No. 1370.

B. Ottrelite-phyllite rock, Liberty, Frederick County. Analyzed for S. H. Williams, but not described.

C. Ottrelite separated from B. Analyses B and C by L. G. Eakins, record No. 1349.

D. Quartz-schist, Shoemaker quarry, near Stevenson Station, Green Spring Valley. Described by Bayley in Bull. 150, p. 302. Contains quartz, muscovite, occasional tourmalines, microcline, zircon, and iron stains. Analysis by Schneider, No. 1370. P. R. C. 119.

E. Mica separated from D. Analysis by Schneider, No. 1377.

F. Sericite-schist, Ladiesburg. Described by Bayley in Bull. 150, p. 317. Contains quartz, sericite, chlorite, a mineral thought to be kaolin, zircon, iron oxide, and rutile. Analysis by George Steiger, record No. 1600. P. R. C. 126.

G. Another sample of F. Analysis by Schneider, No. 1370.

	A.	B.	C.	D.	E.	F.	G.
SiO_2	51.68	34.92	23.40	91.65	44.93	57.24	58.11
Al_2O_3	15.87	32.31	39.31	1.59	29.81	23.48	21.84
Fe_2O_3	1.46	10.21	5.14	3.57	6.10	3.19	2.62
FeO	8.43	8.46	21.94	.21		4.87	5.63
MgO	7.84	1.13	2.18	.17	1.16	.93	1.85
CaO	11.08	.36	trace	none	....	.09	none
Na_2O	1.86	2.12	.20	.07	.50	1.18	.97
K_2O	.34	1.87	.20	1.93	10.28	3.55	3.66
H_2O at 100°	.16	5.29	6.81	....	1.38	.33	.35
H_2O above 100°	.15			.60	4.88	4.65	4.05
TiO_2	.72	3.37	1.19	.13	1.05	.08	.81
P_2O_5	.12	.23	trace	none	....	.09	.21
MnO	.15	trace	trace	trace	trace	none	.19
Li_2O	....	....	....	....	trace	....	....
F	....	....	....	....	.22	....	....
	99.86	100.27	100.37	99.92	100.31	99.68	100.29

VIRGINIA.

A. Andesite, 3½ miles east of Front Royal. Described by Keith in 14th Ann., p. 305. Intermediate between diabase and quartz-porphyry. Contains plagioclase, quartz, magnetite, ilmenite, and a little epidote. Analysis by George Steiger, record No. 1450.

B. Porphyritic felsite or felsophyre, forks of Straight Creek, 3 miles ENE. of Monterey. Described by Darton and Keith in Am. Journ. Sci., 4th series, vol. 6, p. 305. Contains phenocrysts of biotite, orthoclase, and plagioclase, the mica and feldspar being about equal in amount. In the groundmass are feldspar, quartz, magnetite, or ilmenite, and a little secondary chlorite with less muscovite. No glass. Analysis by Hillebrand, record No. 1665.

	A.	B.
SiO_2	51.08	69.56
Al_2O_3	11.37	15.52
Fe_2O_3	11.17	1.67
FeO	5.64	1.19
MgO	3.96	.41
CaO	5.20	1.20
Na_2O	5.54	4.46
K_2O	1.50	4.68
H_2O at 110°	1.31	.34
H_2O above 110°	.19	.67
TiO_2	2.67	.31
P_2O_5	.39	.08
MnO	.22	.07
SrO	....	trace
BaO	....	.10
Li_2O	....	trace
CO_2	....	none
Cl, F	....	(?)
S	....	trace
	100.24	100.26

NORTH CAROLINA.

Rocks A to F collected by Arthur Keith, who furnishes the petrographic data. Analyses B, C, D, and E by W. F. Hillebrand, record No. 1707. Analyses A and F by H. N. Stokes, record No. 1710.

A. Porphyritic rhyolite, 2 miles west of Barmers Elk, Watauga County. Contains orthoclase and plagioclase, with less quartz, epidote chlorite, and pyrite.

B. Quartz-porphyry, 2½ miles northwest of Blowing Rock, Watauga County. Contains quartz and orthoclase, with subordinate sericite chlorite, and biotite.

C. Diorite, east end of Hump Mountain, Mitchell County. Contains plagioclase, orthoclase, and hornblende, with less quartz, biotite magnetite, and garnet.

D. Garnetiferous diabase, 1¾ miles southeast of Cranberry. Contains plagioclase and hornblende, with less garnet, biotite, and magnetite.

	A.	B.	C.	D.
SiO_2	62.35	79.75	46.91	52.11
Al_2O_3	13.24	10.47	15.85	13.70
Fe_2O_3	3.52	.64	2.86	1.22
FeO	6.33	.92	9.95	9.86
MgO	.85	.13	7.01	8.08
CaO	3.34	.15	9.62	12.16
Na_2O	2.79	1.36	2.65	1.31
K_2O	3.95	6.01	.69	.16
H_2O at 110°	.11	.08	.24	.06
H_2O above 110°	1.21	.60	1.62	.53
TiO_2	1.18	.15	2.03	.32
P_2O_5	.57	trace	.26	.05
ZrO_2	....	.05	none	none
Cr_2O_3	none	....	.01	....
V_2O_3	....	....	.03	....
CoO, NiO	none	none	.03	.03
MnO	.08	trace	.22	.20
SrO	trace	trace	trace?	none
BaO	.16	.06	trace?	none
Li_2O	trace	trace	trace	trace
S	....	none	none	trace
	99.68	100.37	99.98	99.79

E. Epidote-chlorite-schist, ¼ mile northeast of Montezuma, Mitchell County. Contains epidote and feldspar, with less chlorite, hornblende, and magnetite.

F. Metamorphosed amygdaloid, 3 miles southeast of Boone, Watauga County. Contains orthoclase and plagioclase, with less sericite, chlorite, and magnetite.

G. Pyroxenite, var. websterite, from Webster. Described by Williams, Amer. Geologist, vol. 6, p. 35. Consists of diopside and bronzite. Analysis by E. A. Schneider, record No. 1096. Material dried at 105°. P. R. C. 388.

H. Spherulitic rhyolite, Sam Christian gold mine, Montgomery County. Described by Diller, Amer. Journ. Sci., 4th ser., vol. 7, p. 337. The rock of the supposed fossil, palæotrochis. Contains feldspar and quartz, with a little biotite and sericite. Analysis by Hillebrand, record No. 1796.

	E.	F.	G.	H.
SiO_2	47.85	43.62	55.14	79.57
Al_2O_3	16.51	17.30	.66	11.41
Fe_2O_3	4.16	14.13	3.48	.20
FeO	7.43	6.83	4.73	.70
MgO	6.24	2.34	26.66	a little
CaO	7.00	1.63	8.39	.21
Na_2O	3.20	3.45	.30	3.46
K_2O	.82	3.03	....	3.52
H_2O at 110°	.21	.30	.38	.18
H_2O above 110°	4.00	2.93		.61
TiO_2	2.28	2.75	trace	.11
P_2O_5	.35	1.34	.23	trace
ZrO_2	.03	....	....	....
Cr_2O_3	.01	none	.25	....
V_2O_3	.05	....	....	....
CoO, NiO	.03	none	.11	....
MnO	.24	trace	.03	none
SrO	trace?	trace	....	....
BaO	trace?	.09	....	.05
Li_2O	trace	trace	....	....
	100.41	99.74	100.36	100.02

The following rocks from Corundum Hill were collected, analyzed, and described by T. M. Chatard, Bull. 42, p. 45.

I. Altered gneiss. Made up of micaceous scales, with grains of quartz and some earthy matter. Record No. 238.

J. Dunite. Olivine rock containing a little chromite. Record No. 256.

K, L. Yellow, clay-like alterations of dunite. Record Nos. 254, 255.

Other analyses of altered rocks are given in the paper, and also analyses of associated minerals.

	I.	J.	K.	L.
SiO_2	64.27	40.11	40.18	40.04
Al_2O_3	16.75	.88	1.35	3.17
Fe_2O_3	6.08	1.20	10.97	12.15
FeO	.89	6.09		
MgO	1.74	48.58	43.84	42.97
CaO	.25			
Na_2O	.89			
K_2O	3.09			
H_2O (Ign.)	4.97	2.74	2.01	2.14
TiO_2	1.32		none	none
P_2O_5	.05			
Cr_2O_3		.18	1.41	
MnO	.07			
Chromite		.56		.17
	100.37	100.34	99.76	100.64

GEORGIA.

Rocks collected by A. H. Brooks, who supplies tne petrographic data. Hitherto unpublished. Analyses by H. N. Stokes, record No. 1727.

A. Meta-quartz-diorite, 2 miles southwest of Sweden, Gordon County. Contains plagioclase, near labradorite, green hornblende, sometimes diallage, much vitreous quartz, and accessory magnetite, ilmenite, and orthoclase. Also secondary epidote, zoisite, uralite, chlorite, garnet, calcite, and leucoxene.

B. Augite-microcline-granite, 1 mile east of Rowland, Bartow County. Contains microcline, some plagioclase, abundant pyroxene partly altered into chiefly uralite and chlorite, some biotite with frequent inclusions of rutile, much blue vitreous quartz, apatite, zircon, and magnetite.

C. Quartz-gabbro, 2 miles southeast of Walleska, Cherokee County. Closely related to B. Contains essentially plagioclase, near labradorites, and augite. Accessory magnetite, ilmenite, apatite, and zoisite. Orthoclase is sparingly present. Quartz occurs in vitreous masses.

	A.	B.	C.
SiO_2	69.87	67.98	56.20
Al_2O_3	12.02	14.84	15.46
Fe_2O_3	1.42	1.00	1.54
FeO	3.49	3.15	9.76
MgO	2.30	.91	1.83
CaO	7.86	2.17	5.39
Na_2O	.66	2.66	2.78
K_2O	.11	4.76	2.56
H_2O at 110°	.18	.14	.16
H_2O above 110°	.89	.49	.59
TiO_2	.69	.84	2.25
P_2O_5	.17	.34	1.13
MnO	.16	trace	.13
BaO	none	.20	.17
SrO	none	trace	trace
Li_2O	trace	trace	none
CO_2	.43	none	none
S	none	.08	.07
SO_3	none	trace	trace
Cl	none	trace	trace
F	(?)	trace	trace
C (graphite)	....	.21	....
	100.25	99.77	100.02

KENTUCKY.

1. THE ELLIOTT COUNTY DIKE.

Described by Diller in Bull. 38. Also in Amer. Journ. Sci., 3d series, vol. 32, p. 125.

A peridotite, var. kimberlite, consisting largely of olivine, sometimes altered to serpentine. Pyrope, ilmenite, a few scales of biotite, a little enstatite, and a trace of apatite are present as primary minerals. Secondary minerals are serpentine, dolomite, magnetite, and octahedrite. P. R. C. 799.

A granitic rock occurs with the peridotite. It consists chiefly of feldspar, orthoclase, and plagioclase, with a considerable amount of quartz and ilmenite, and traces of hornblende, sphene, and apatite.

Analyses by T. M. Chatard, record Nos. 272, 273, 282, 305, 351, 352, 353, 354, and 358.

A. Granite.
B. Peridotite (kimberlite).
C. Olivine from peridotite.
D. Garnet from peridotite.
E. Ilmenite from peridotite.

	A.	B.	C.	D.	E.
SiO_2	60.56	29.81	40.05	41.32	.76
Al_2O_3	16.19	2.01	.39	21.21	2.84
Fe_2O_3	5.19	5.16	2.36	4.21	9.13
FeO	2.41	4.35	7.14	7.93	27.81
MgO	1.30	32.41	46.68	19.32	8.68
CaO	2.09	7.69	1.16	4.94	.23
Na_2O	4.78	.11	.08	.07	.19
K_2O	4.82	.20	.21		
H_2O, 110°		8.92	.14	.17	.20
H_2O, ign	.51		.66		
TiO_2	1.19	2.20	.07	.16	49.32
P_2O_5	.30	.35	.04	none	trace
Cr_2O_3		.43	.24	.91	.74
MnO	.36	.23	.20	.34	.20
NiO		.05			
CoO			trace		
CO_2		6.66	?		
SO_3		.28			
	99.70	100.86	99.42	100.58	100.10

The following analyses are of sedimentary rocks adjoining the dike:

F. Calcareous standstone.

G. Fine-grained fissile sandstone.

H. Indurated shale.

I. Fragment of shale included in the peridotite.

	F.	G.	H.	I.
SiO_2	60.78	60.25	41.32	35.53
Al_2O_3	10.54	20.18	20.71	18.23
Fe_2O_3	3.27	1.53	2.59	2.46
FeO	....	3.42	5.46	4.81
MgO	1.59	3.52	1.91	2.01
CaO	10.15	.51	9.91	21.17
Na_2O	1.41	.39	7.19	2.53
K_2O	2.36	3.17	.88	1.08
H_2O, 110°	.85	1.94	....	1.40
H_2O, ign	2.32	5.17	8.78	9.00
TiO_2	.03	.23	.48	.95
P_2O_5	.09	.10	.08	.08
Cr_2O_3	....	....	trace	....
MnO	.10	.10	.17	.13
CO_2	6.29	....	.55	.88
	99.78	100.51	100.03	100.26

H was dried five hours at 110°, previous to analysis.

2. THE CRITTENDEN COUNTY DIKE.

A mica-peridotite, described by Diller in Amer. Journ. Sci., 3d series, vol. 44, p. 286. Contains biotite, serpentine, and perofskite, with less apatite, muscovite, magnetite, calcite, chlorite, and some other secondary products. P. R. C. 800.

A. The rock described by Diller. Analysis by W. F. Hillebrand, record No 1241.

B. An unpublished analysis of probably the same rock, from a shaft 40 feet deep at Marion. Collected by J. R. Procter, analyzed by L. G. Eakins, record number 965.

	A.	B.
SiO_2	33.84	34.50
Al_2O_3	5.88	14.37
Fe_2O_3	7.04	2.85
FeO	5.16	4.46
MgO	22.96	21.81
CaO	9.46	11.43
Na_2O	.33	.51
K_2O	2.04	1.50
H_2O	7.50	7.14
TiO_2	3.78	....
P_2O_5	.89	.77
Cr_2O_3	.18	....
MnO	.16	....
NiO	.10	....
CoO	trace	....
BaO	.06	....
Cl	.05	....
CO_2	.43	.21
SO_3	....	.60
	99.86	100.15

TENNESSEE.

Gabbro, 2 miles south of Limestone Cove, Unicoi County. Collected by Arthur Keith, who furnishes the petrographic data. Analysis by W. F. Hillebrand, record No. 1707. Contains hypersthene, plagioclase, and magnetite.

SiO_2	48.11	ZrO_2	(?)
Al_2O_3	14.74	Cr_2O_3	.01
Fe_2O_3	2.54	V_2O_3	.03
FeO	11.85	NiO, CoO	.03
MgO	5.10	MnO	.19
CaO	6.72	SrO	.02
Na_2O	2.92	BaO	.04
K_2O	1.92	Li_2O	trace
H_2O at 110°	.27	FeS_2	*a* .13
H_2O above 110°	1.73		99.96
TiO_2	3.17		
P_2O_5	.44		

a Equivalent to 0.07 S. Assumed to be pyrite, no pyrrhotite being present.

MISSOURI.

Granite and porphyry, 6 miles east of Ironton. Described by Haworth in Mo. Geol. Survey, vol. 8, Annual Report, pp. 140, 180, and 213. Analyses by W. H. Melville, record No. 1206.

A, B. Granite. A, P. R. C. 1027; B, P. R. C. 1028.

C, D. Porphyry. C, P. R. C. 1029; D, P. R. C. 1030.

Rocks composed principally of orthoclase and quartz, with some microcline, plagioclase, and biotite, and minor accessory minerals.

	A.	B.	C.	D.
SiO_2	69.94	72.35	71.33	71.88
Al_2O_3	15.19	13.78	12.55	12.88
Fe_2O_3	1.88	1.87	3.75	3.05
FeO	.60	.36	.85	1.05
MgO	.92	.42	.58	.33
CaO	1.15	.87	.94	1.13
Na_2O	3.95	4.44	4.52	4.21
K_2O	4.29	4.49	4.20	4.46
H_2O at 100°	.14	.22	.12	.17
H_2O above 100°	.85	.54	.30	.26
TiO_2	.25	.44	.55	.22
P_2O_5	.13	.13	.16	.15
NiO	trace	.20	.15	.02
MnO	.03	.06	.04	trace
	99.32	99.87	100.04	99.81

ARKANSAS.

Ouachitite, dike near Maple Spring, 4 miles southwest of Hot Springs. Described by Kemp, in Ann. Rep. Geol. Survey Arkansas, 1890, vol. 2, p. 399. A dike rock of the monchiquite group. Contains abundant and conspicuous augite and biotite, magnetite, and minor accessory minerals in a groundmass considered by Kemp as glass. Calcite and other secondary products are also present. According to Pirsson, Journ. Geol., vol. 4, p. 679, the so-called "glass" in the monchiquites is really analcite. Analysis by L. G. Eakins, record No. 1023.

SiO_2	36.40	K_2O	3.01
Al_2O_3	12.94	H_2O	2.36
Fe_2O_3	8.27	TiO_2	.42
FeO	4.59	P_2O_5	1.04
MgO	11.44	CO_2	3.94
CaO	14.46		99.84
Na_2O	.97		

TEXAS.

A. Quartz-pantellarite, Vieja Mountains, San Carlos, Presidio County. Description furnished by E. C. E. Lord. Contains anorthoclase, augite, and grains of quartz in a groundmass of ægirine augite, a brown hornblende, which is probably barkevikite, orthoclase, and quartz. Magnetite and apatite are present as accessory minerals. Analysis by George Steiger, record No. 1581.

The following rocks from Uvalde County were collected by T. Way-nd Vaughan. Petrographic data furnished by Whitman Cross. nalyses by W. F. Hillebrand, record No. 1681.

B. Plagioclase-basalt, Pinto Mountain, Brackett quadrangle. Con-ains olivine, augite, plagioclase (labradorite), biotite, a very little lkali feldspar (?), magnetite, and apatite. Sp. gr. 3.118, 20°. P. R. . 1067.

C. Basanite, Mount Inge, Uvalde quadrangle. Contains sanidine, ephelite, hornblende, augite, ægirine augite, olivine, magnetite, apa-ite, and a trace of pyrite. Sp. gr. 2.770, 20°. P. R. C. 1069.

D. Rock of basaltic habit, allied to C, 1 mile northeast of Big Iountain, Uvalde quadrangle. Contains alkali feldspar, augite, mag-etite, and variable amounts of olivine, nephelite, ægirite, biotite, and eolitic minerals. Sp. gr. 2.742, 23°. P. R. C. 1068.

	A.	B.	C.	D.
SiO_2	68.71	45.11	48.13	48.23
Al_2O_3	13.45	*a* 12.44	18.44	17.43
Fe_2O_3	5.31	2.67	3.41	2.77
FeO	.75	9.36	4.30	5.92
MgO	.19	11.56	3.06	2.99
CaO	.96	10.61	5.89	6.38
Na_2O	4.63	3.05	8.00	6.87
K_2O	5.51	1.01	3.80	2.78
H_2O at 110°	.13	.16	.18	.54
H_2O above 110°	.36	.78	1.59	2.84
TiO_2	.21	2.34	1.74	2.00
P_2O_5	.04	.51	.49	.69
ZrO_2		(?)	.05	.04
Cr_2O_3			none	none
V_2O_3		.04		.04
NiO		.04	.02	trace
MnO	.14	.22	.19	.18
SrO	none	trace	.10	.08
BaO	none	trace	.10	.08
Li_2O	none	none	trace	trace
S		.01	.09	.08
SO_3	.05			
Cl		.11	.29	.03
F		undet.	.06	undet.
	100.44	100.02	99.93	99.97
Less O		.02	.09	
		100.00	99.84	

a Including Cr_2O_3.

E. Phonolite, hill between Black and Big mountains, Uvalde quad rangle. Contains sanidine, nephelite, and ægirite, and very littl brown hornblende, augite, and magnetite. Sp. gr. 2.559, 19.5°. P R. C. 1070.

F. The portion of E soluble in 1:40 dilute nitric acid.

G. Nepheline-basalt, Tom Munns Hill, Uvalde quadrangle. Con tains olivine, augite, nephelite, magnetite, and apatite. Sp. gr. 3.148 19°. P. R. C. 1065.

H. The portion of G soluble in 1:40 dilute nitric acid.

	E.	F.	G.	H.
SiO_2	54.42	26.90	40.32	12.27
Al_2O_3	20.76	14.34	a 9.46	6.09
Fe_2O_3	2.64	....	4.75	....
FeO	1.33	.60	7.48	2.83
MgO	.22	(?)	18.12	6.48
CaO	1.34	.30	10.55	1.45
Na_2O	10.41	8.32	2.62	2.39
K_2O	4.89	1.22	1.10	.93
H_2O at 110°	.22	(?)	.57	(?)
H_2O above 110°	2.50	(?)	1.25	(?)
TiO_2	.40	....	2.66	....
P_2O_5	.11	.11	.68	.68
ZrO_2	.15	....	none	....
Cr_2O_3	none	....	....	....
NiO	none	....	.06	....
MnO	.15	....	.25	....
SrO	trace	....	.03	....
BaO	.04	....	.06	....
Li_2O	trace	....	trace	....
S	.01	....	.01	....
SO_3	....	....	.03	....
Cl	.23	....	.05	....
F	none	....	.04	....
	99.82	51.79	100.09	33.12
Less O	.05	....	.03	....
	99.77	....	100.06	....

a Including Cr_2O_3

I. Nepheline-basalt, Black Mountain, Uvalde quadrangle. Contains olivine, augite, nephelite, magnetite, and apatite. Sp. gr. 3.200, 21.5°. P. R. A. 1066.

J. The portion of I soluble in 1:40 dilute nitric acid.

K. Augite from I. Violet in color, very pure.

L. Nepheline-melilite-basalt, from about 3 miles southwest of Uvalde. Contains nephelite, melilite, olivine, augite, magnetite, and apatite. Sp. gr. 3.150, 20.5°. P. R. C. 1064.

M. The portion of L soluble in 1:40 dilute nitric acid.

	I.	J.	K.	L.	M.
SiO_2	39.92	12.00	45.23	37.96	19.32
Al_2O_3	8.60	5.15	7.73	10.14	7.12
Fe_2O_3	4.40	....	2.95	3.69	....
FeO	8.00	3.38	4.07	7.59	3.16
MgO	20.17	7.16	12.25	14.69	6.52
CaO	10.68	1.33	23.37	16.28	7.75
Na_2O	1.91	1.77	.47	2.18	2.11
K_2O	1.03	.77	.12	.69	.67
H_2O at 110°	.43	(?)	.37	.39	(?)
H_2O at above 110°	1.45	(?)		1.82	(?)
Ti_2O	2.70	....	4.28	2.93	trace
P_2O_5	.51	.51	none	1.13	1.13
ZrO_2	none	....	....	none	....
Cr_2O_3	.14	....	....	.08	....
V_2O_3	.04	....	....	.05	....
NiO	.06	....	.05	.04	....
MnO	.24	....	.07	.22	....
SrO	.04	....	none	.05	....
BaO	.06	....	none	.06	....
Li_2O	trace	....	trace	trace	....
SO_3	....	....	....	.03	....
S	trace	....	....	.04	....
Cl	trace	....	....	trace	....
F	.07	....	....	.07	....
	100.45	32.07	100.96	100.13	47.78
Less O	.03	....	....	.03	....
	100.42	....	....	100.10	....

LAKE SUPERIOR REGION.

1. MARQUETTE REGION, MICHIGAN.

Rocks mostly described by Van Hise and Bayley. When not otherwise specified the descriptions have been published in Mon. XXVIII, and partly in 15th Ann., p. 485.

A. Peridotite, near Opin Lake, E. ¼ sec. 27, T. 48 N., R. 27 W. Contains diallage, olivine, magnetite, and plagioclase. The diallage is partly chloritized, and the olivine is partly serpentinized. Analysis by W. F. Hillebrand, record No. 1452. P. R. C. 996.

B. Altered greenstone, Marquette district. Analysis by George Steiger, record No. 1586, hitherto unpublished. P. R. C. 988.

C. Grünerite-magnetite-schist, sec. 11, T. 47 N., R. 27 W. Mainly impure grünerite, with magnetite and quartz. Analysis by W. H. Melville, record No. 1403. P. R. C. 984.

D. Like C, from sec. 18, T. 47 N., R. 28 W. Analysis by Melville, record No. 1403. P. R. C. 980.

E. Like C and D, from sec. 20, T. 46 N., R. 30 W. Analysis by H. N. Stokes, record No. 1546. C, D, and E are similar schists, and alike in mineralogical composition.

	A.	B.	C.	D.	E.
SiO_2	39.37	48.85	46.94	49.70	46.25
Al_2O_3	4.47	15.83	.66	1.35	.92
Fe_2O_3	4.96	2.50	4.51	3.10	30.62
FeO	9.13	10.79	33.72	37.19	16.92
MgO	26.53	5.82	6.64	5.72	2.13
CaO	3.70	6.20	3.22	.68	1.69
Na_2O	.50	2.79	.16	trace	none
K_2O	.26	1.31	....	....	none
H_2O at 110°	.87	.27	} .67	} 1.40	....
H_2O above 110°	7.08	3.77			.42
TiO_2	.66	1.28	none	....	none
P_2O_5	.17	.22	.07	.12	.07
Cr_2O_3	.68	....	....	....	....
MnO	.12	.11	.31	.93	1.01
NiO	.21	....	....	....	none
CuO	....	....	....	....	trace
SrO	trace	.09	....	....	none
BaO	trace	none	....	....	none
CO_2	1.23	none	2.79	....	none
SO_3	....	.06	....	....	....
	99.94	99.89	99.69	100.19	100.03

F. Green schist, sec. 34, T. 48 N., R. 27 W., near center of section. Contains plagioclase, chlorite, and quartz. Analysis by George Steiger, record No. 1447. P. R. C. 986.

G. Sericite-schist associated with the preceding. Mainly sericite and quartz. Analysis by Steiger, No. 1447. P. R. C. 985.

H. Dark-gray, foliated schist, SE. corner of sec. 30, T. 47 N., R. 30 W. Contains quartz, plagioclase, orthoclase, and biotite. Analysis y Steiger, No. 1525. P. R. C. 991.

I. Schistose gneiss, NW. ¼ of sec. 35, T. 47 N., R. 26 W. Contains quartz, kaolin, sericite, plagioclase, chlorite, magnetite, and apatite. Analysis by Steiger, No. 1525.

J. Novaculite from Marquette. Described by Williams in Bull. 62. Contains quartz and sericite. Analysis by W. F. Hillebrand, record No. 759.

	F.	G.	H.	I.	J.
SiO_2	61.35	70.76	63.50	82.38	76.99
Al_2O_3	16.45	14.83	17.89	11.32	13.92
Fe_2O_3	.94	1.46	1.12	.97	.45
FeO	4.20	3.09	5.38	.26	.77
MgO	3.12	1.99	1.22	.17	1.12
CaO	3.46	.36	2.34	.22	.32
Na_2O	5.24	.47	2.55	.59	.56
K_2O	1.05	3.50	2.43	1.04	3.65
H_2O at 100°	.10	.09	.22	.18	2.35
H_2O above 100°	2.51	2.70	2.04	2.33	
TiO_2	.26	.33	.62	.14	
P_2O_5	.18	.26	.19	.09	trace
MnO			trace	none	trace
Li_2O					trace
CO_2	1.98				
	100.84	99.84	99.50	99.69	100.13

2. CRYSTAL FALLS DISTRICT, MICHIGAN.

Rocks described by J. Morgan Clements and H. L. Smyth, in Mon. XXXVI. A, B, C, and D by Smyth, p. 274. Analyses by H. N Stokes, record No. 1721.

A. Granite, sec. 2, T. 41 N., R. 30 W. Contains quartz, orthoclase microcline, plagioclase, biotite, muscovite, magnetite, hematite, titanite, and occasional apatite.

B. Gneiss, sec. 35, T. 42 N., R. 29 W. Same minerals as in A.

C. Mica-schist, sec. 35, T. 42 N., R. 29 W. Contains biotite, quartz some microcline, and magnetite.

D. Amphibolite, sec. 32, T. 42 N., R. 28 W. Contains hornblende plagioclase, biotite, and quartz, with a little rutile and magnetite.

	A.	B.	C.	D.
SiO_2	76.10	74.37	64.71	50.36
Al_2O_3	12.95	13.34	16.43	13.26
Fe_2O_3	.65	.92	1.83	6.30
FeO	.09	.21	3.84	9.34
MgO	.14	.27	2.97	5.55
CaO	.12	.50	.08	7.85
Na_2O	2.36	2.50	.11	2.11
K_2O	6.50	6.70	5.63	1.14
H_2O at 110°	.17	.12	.31	.16
H_2O above 110°	.48	.44	2.79	1.55
TiO_2	.07	.07	.72	1.77
P_2O_5	.02	.01	.02	.20
MnO	trace	trace	trace	trace
	99.65	99.45	99.44	99.59

Ba, Sr, Cl, F, S, SO_3 not looked for.

The following rocks, with one exception, are described by Clements in his portion of Mon. XXXVI:

E. Mica-diorite, sec. 28, T. 42 N., R. 32 W., southeast of Crystal Falls. Contains plagioclase (andesine), orthoclase, quartz, biotite, hornblende, and titaniferous magnetite. Analysis by Stokes, record No. 1721.

F. Hornblende-gabbro, sec. 29, T. 42 N., R. 31 W., west bank Michigamme River, east of Crystal Falls. Contains labradorite, hornblende, and iron oxide, with subordinate pyroxene, biotite, and orthoclase. Analysis by George Steiger, record No. 1712.

G. Bronzite-norite, same locality as F. Contains bronzite, hornblende, and labradorite. Analysis by Steiger, record No. 1712.

H. Wehrlite, sec. 29, T. 42 N., R. 31 W., on Michigamme River, east of Crystal Falls. Contains hornblende, pyroxene, olivine, biotite, and iron oxide. Analysis by Stokes, record No. 1721.

I. Picrite-porphyry, sec. 27, T. 44 N., R. 32 W., northwest of Mansfield. Principal minerals serpentine, amphibole, chlorite, ilmenite, all but the last being secondary. Analysis by Stokes, record No. 1721.

	E.	F.	G.	H.	I.
SiO_2	58.51	49.80	48.23	44.99	37.36
Al_2O_3	16.32	19.96	18.26	5.91	4.76
Fe_2O_3	2.11	6.32	1.26	3.42	6.61
FeO	4.43	.49	6.10	8.30	6.12
MgO	3.73	7.05	10.84	21.02	31.11
CaO	3.92	11.33	9.39	9.79	1.19
Na_2O	3.11	2.22	1.34	.91	trace
K_2O	4.08	.61	.73	.74	trace
H_2O at 110°	.23	.13	.26	.63	.65
H_2O above 110°	2.00	1.71	2.00	3.19	10.37
TiO_2	.72	.79	1.00	.97	.79
P_2O_5	.30	.07	.07	.05	.06
Cr_2O_3	....	....	....	.25	.62
MnO	trace	....	....	trace	trace
NiO	....	....	....	....	.04
CO_2	none	.15	.43	trace?	none
	99.46	100.63	99.91	99.17	99.68

Ba, Sr, Cl, F, S, SO_3 not looked for.

J. Pre-Cambrian nonporphyritic metabasalt, from the Hemlock formation. Contains plagioclase, light-green hornblende, epidote-zoisite, chlorite, calcite, muscovite, apatite, sphene, quartz, pyrite, and magnetite.

K. Porphyritic metabasalt, Hemlock formation. Same minerals as in J, with feldspar phenocrysts.

L. Porphyritic metabasalt, like K.

M. Metadolerite, large dike in T. 43 N., R. 31 W., east of Mansfield. Hitherto unpublished. Petrographic data furnished by C. R. Van Hise. Contains uralite, labradorite, and ilmenite.

Analyses J, K, and L by H. N. Stokes, record No. 1617.

Analysis M by George Steiger, record No. 1814.

	J.	K.	L.	M.
SiO_2	46.47	47.20	52.59	44.29
Al_2O_3	16.28	15.36	15.89	17.46
Fe_2O_3	3.15	3.06	6.12	3.82
FeO	8.96	8.87	3.96	10.35
MgO	6.56	4.20	5.04	7.03
CaO	7.90	5.05	5.55	8.68
Na_2O	3.64	4.72	5.79	2.19
K_2O	.21	1.40	.67	.71
H_2O at 110°	.28	.16	.16	.21
H_2O above 110°	3.89	3.04	2.16	4.11
TiO_2	1.28	3.30	1.36	1.40
P_2O_5	.13	.36	.15	.20
V_2O_3	....	....	.04	....
Cr_2O_3	.01	none	trace	....
MnO	.09	.20	.25	trace
CuO	trace	trace	trace	....
SrO	none	trace	none	....
BaO	none	trace	trace	none
Li_2O	trace	trace	none	....
CO_2	1.26	3.34	none	....
S	none	trace	none	....
F	trace	trace	trace	....
	100.11	100.26	99.73	100.45

N. Adinole, sec. 8, T. 43 N., R. 31 W., near Mansfield. Contains actinolite, albite, quartz, some chlorite, and epidote. Analysis by George Steiger, record No. 1709.

O. Spilosite. Contains quartz, feldspar, chlorite, epidote, and a little biotite.

P. Spilosite. Contains quartz, feldspar, actinolite, and epidote.

Analyses O and P by H. N. Stokes, record No. 1617. These three rocks are contact derivatives of the Mansfield clay slate, q. v.

	N.	O.	P.
SiO_2	74.16	52.51	57.77
Al_2O_3	11.85	19.00	19.33
Fe_2O_3	.82	3.31	1.29
FeO	1.66	7.19	3.37
MgO	2.10	3.29	4.35
CaO	2.10	1.55	1.71
Na_2O	6.57	6.72	8.22
K_2O	.15	.70	.22
H_2O at 110°	.05	.34	.18
H_2O above 110°	.52	3.26	2.34
TiO_2	.37	1.70	.92
P_2O_5	.08	.15	.04
MnO	.06	trace	trace
SrO	none	trace	trace
BaO	none	trace	none
V_2O_3	....	....	.02
Li_2O	....	trace	none
CO_2	.09	none	none
C	.18	....	....
F	....	trace	none
	100.76	99.72	99.76

3. MENOMINEE RIVER.

1st. STURGEON FALLS GABBRO.

From Sturgeon Falls, Menominee River, sec. 27, T. 39 N., R. 29 W., Michigan. Described by Williams, Bull. 62, p. 67.

A. Saussurite-gabbro. Contains plagioclase, almost wholly altered to saussurite, diallage, hornblende, and ilmenite, with quartz, calcite, and chlorite as alteration products.

B. The same, altered and somewhat schistose. Feldspar much altered into calcite, with secondary quartz and sericite; pyroxene and hornblende changed to chlorite. Leucoxene common.

C. Light-gray, silvery schist, derived from gabbro. Contains chlorite, calcite, and a little quartz, with remnants of feldspar and some leucoxene. Analyses by R. B. Riggs, record Nos. 389, 390, 391. Material dried at 105°. TiO_2 undetermined.

	A.	B.	C.
SiO_2	51.46	38.05	45.70
Al_2O_3	14.35	24.73	16.53
Fe_2O_3	3.90	5.65	4.63
FeO	5.28	6.08	3.89
MgO	9.54	11.58	9.57
CaO	9.08	1.25	4.28
Na_2O	2.92	2.54	.55
K_2O	.24	1.94	3.82
H_2O	3.30	7.53	4.70
CO_2	.20	.93	5.95
	100.27	100.28	99.62

2D. LOWER QUINNESEC FALLS, MENOMINEE RIVER.

Described by Williams, Bull. 62, pp. 89, 91.

A. Gabbro-diorite, shore below falls, Wisconsin side. Contains saussurite, hornblende, and ilmenite. Some calcite in the saussurite. Hornblende partly altered to chlorite and ilmenite to leucoxene.

B. The same, schistose form. Contains less saussurite. Hornblende and ilmenite completely altered into chlorite and leucoxene. Calcite present, and also porphyritic feldspar.

C. Silvery schist, adjoining B, and derived from gabbro. Resembles B in general, without the feldspar crystals. Calcite and sericite are present, and rutile in place of leucoxene.

D. Dark, massive greenstone. Contains hornblende, chlorite, epidote, quartz, leucoxene, with some ilmenite and traces of original feldspar.

E. Dark, schistose greenstone, forming a band in D. Chlorite entirely replaces hornblende, and rutile replaces leucoxene. Some feldspar, quartz, and calcite.

Analyses by R. B. Riggs, record Nos. 384, 385, 386, 387, 388. Material dried at 105°.

	A.	B.	C.	D.	E.
SiO_2	47.96	49.19	46.21	43.80	44.49
Al_2O_3	16.85	18.71	18.38	16.08	16.37
Fe_2O_3	4.33	5.03	3.30	9.47	5.07
FeO	4.17	4.04	3.90	10.50	5.50
MgO	9.15	7.98	7.03	6.54	7.50
CaO	13.25	5.92	6.28	7.81	7.94
Na_2O	1.25	1.44	2.14	1.96	2.59
K_2O	.30	.77	.35	.34	.56
H_2O	2.89	5.05	3.82	3.99	4.99
CO_2	.08	1.82	8.32	.08	5.38
	100.23	99.95	99.73	100.57	100.39

3D. UPPER QUINNESEC FALLS, MENOMINEE RIVER.

Described by Williams, Bull. 62, pp. 104, 113, 114, 121.

A. Light greenstone. Contains hornblende, feldspar much altered to saussurite, ilmenite with leucoxene border, and some secondary quartz.

B. Mica-diorite-porphyry. Mainly andesitic feldspar and biotite, with apatite, zircon, sphene, and some calcite.

C. Biotite-gneiss, Michigan side. Contains biotite, soda-orthoclase, and quartz. Sphene common, zircon and apatite present.

D. Schistose quartz-porphyry. Contains quartz, feldspar, sericite, some chlorite, anatase, and tourmaline, with zircon and apatite sparingly.

A, B, and D are from the Wisconsin side of the river.

Analyses by R. B. Riggs, record Nos. 392, 393, 394, 395. Material dried at 105°.

	A.	B.	C.	D.
SiO_2	48.35	54.83	67.77	66.69
Al_2O_3	15.40	25.49	16.61	16.69
Fe_2O_3	4.04	1.61	2.06	2.06
FeO	4.63	1.65	1.96	.93
MgO	11.61	1.96	1.26	1.15
CaO	10.38	6.08	1.87	1.40
Na_2O	1.87	5.69	4.35	2.46
K_2O	.35	1.87	2.35	5.23
H_2O	3.60	1.18	1.69	1.70
CO_2	.08	.18	.19	1.42
	100.31	100.54	100.11	99.73

4TH. SCHIST FROM THE ARAGON IRON MINE.

Talcose-schist. Description, hitherto unpublished, furnished by W. S. Bayley. Analysis by George Steiger, record No. 1835. Consists mainly of talc and quartz, with a little limonite and other iron oxides.

SiO_2	49.56	H_2O at 110°	4.50
Al_2O_3	10.12	H_2O above 110°	7.66
Fe_2O_3	5.87	TiO_2	.60
FeO	.13	P_2O_5	.04
MgO	20.53	MnO	trace
CaO	.72	CO_2	none
Alkalies	none		
			99.73

4. PENOKEE-GOGEBIC REGION.

Rocks mostly described by Van Hise in Mon. XIX. Analyses A to G by T. M. Chatard, record Nos. 991, 992, 993, 994, 905.

A. Diabase, near SE. corner of sec. 13, T. 47 N., R. 46 W., Michigan. Contains plagioclase, augite, magnetite, apatite, and olivine, with some ilmenite and leucoxene. P. R. C. 1001.

B. Same dike as A, partly altered. The pyroxene is altered to amphibole, and the latter partly to biotite. Biotite has also been derived from feldspar. P. R. C. 1000.

C. Feldspar separated from A.

D. Altered diabase, Aurora mine, NE. ¼ of SW. ¼ of sec. 23, T. 47 N., R. 47 W., Michigan. P. R. C. 1002.

	A.	B.	C.	D.
SiO_2	47.90	46.85	51.18	41.60
Al_2O_3	15.60	22.62	27.00	37.20
Fe_2O_3	3.69	5.12	3.19	3.21
FeO	8.41	1.58	undet.	.30
MgO	8.11	2.01	1.92	.02
CaO	9.99	1.25	11.70	.23
Na_2O	2.05	.80	3.48	.07
K_2O	.23	2.66	.41	....
H_2O at 105°	.15	3.12	1.19	.29
H_2O above 105°	2.34	8.25		13.54
TiO_2	.82	1.12	....	3.79
P_2O_5	.13	.16	....	.14
Cr_2O_3	trace	....	....	....
MnO	.17	2.54	.17	.08
NiO	.10	.08	....	....
BaO	.05	.10	....	trace
CO_2	.38	1.89	....	.38
	100.12	100.15	100.24	100.85

E. Feldspar separated from gabbro, southern half of sec. 14, T. 44 N., R. 4 W., Wisconsin.

F, G. Feldspars separated from olivine-diabase, NE. $\frac{1}{4}$ of sec. 13, T. 45 N., R. 1 W., Wisconsin.

	E.	F.	G.
SiO_2	51.99	61.65	56.15
Al_2O_3	29.32	19.91	26.05
Fe_2O_3	1.23	2.28	1.98
FeO		undet.	undet.
MgO	.63	.61	.54
CaO	12.60	4.12	8.70
Na_2O	2.91	4.74	4.79
K_2O	.28	5.72	1.56
H_2O at 105°	.03	.95	.13
H_2O above 105°	.54		.64
MnO	trace	trace	.13
	99.53	99.98	100.67

The following analyses, by W. F. Hillebrand, of separations from the gabbro of Ashland County, Wisconsin, were made for the late R. D. Irving, but were never published by him:

H. Magnetite, record No. 687. Partial analysis.

I. Feldspar, record No. 688.

J. Diallage, record No. 686.

For convenience I also include here, although it is decidedly out of classification—

K. Graywacke, Hurley, Wisconsin. Described by Bayley in Bull. 150, p. 84. Analysis by H. N. Stokes, record No. 1314. Contains quartz, feldspars, iron oxides, and probably kaolin. In the cement are chlorite, quartz, magnetite, pyrite, rutile, occasionally biotite, and either muscovite or kaolin. P. R. C. 20.

	H.	I.	J.	K.
SiO_2	....	53.30	49.80	76.84
Al_2O_3	....	29.03	2.86	11.76
Fe_2O_3	50.29	.55	2.48	.55
FeO	30.70	.23	10.82	2.8[illegible]
MgO	....	.13	15.33	1.39
CaO	....	11.40	16.50	.70
Na_2O	....	4.87	.51	2.57
K_2O	....	.40	.12	1.62
H_2O	....	.23	.33	1.87
TiO_2	8.77	trace	1.29	....
P_2O_5	....	trace	trace	....
MnO	....	none	.37	trace
SrO	....	trace	none	....
BaO	....	trace	none	....
Li_2O	....	none	trace?	....
	89.46	100.14	100.41	100.18

5. ROCKS OF PIGEON POINT, MINNESOTA.

Described by Bayley in Bull. 109. Also partially in Amer. Journ. Sci., 3d series, vol. 37, p. 54. A and B are also described in Bull. 150, p. 274.

A. Olivine diabase. Contains labradorite, olivine, pyroxene, apatite, and magnetite. Analysis by W. F. Hillebrand, record No. 496.

B. Diallage separated from diabase. Partial analysis by R. B. Riggs, record No. 607.

C. Rock lying between the diabase and the adjacent red porphyry. Contains red feldspar, quartz, hornblende, chlorite, magnetite, apatite, and rutile. Analysis by W. F. Hillebrand, record No. 500. P. R. C. 1018.

	A.	B.	C.
SiO_2	49.88	48.34	57.98
Al_2O_3	18.55	2.90	13.58
Fe_2O_3	2.06	4.68	3.11
FeO	8.37	14.15	8.68
MgO	5.77	11.34	2.87
CaO	9.72	15.10	2.01
Na_2O	2.59	....	3.56
K_2O	.68	....	3.44
H_2O	1.04	....	2.47
TiO_2	1.19	1.98	1.75
P_2O_5	.16	....	.29
ZrO_2	none	....	....
MnO	.09	....	.13
SrO	trace	....	trace
BaO	.02	....	.04
Li_2O	none	....	trace
Cl	trace	....	trace
	100.12	98.49	99.91

D. Red soda-granite. Contains feldspar, quartz, chlorite, some muscovite, rutile, leucoxene, hematite and apatite, with sometimes secondary calcite. Granular variety. Analysis by W. F. Hillebrand, record No. 495. Dried at 110°.

E. Same as D, porphyritic variety. Called by Bayley a quartz-keratophyre. Analysis by Hillebrand, record No. 497.

F. Similar red porphyry, Little Brick Island, Lake Superior, near Pigeon Point. Consists chiefly of feldspar and quartz, with augite occasionally present. Analysis by L. G. Eakins, record No. 1059.

G. Red feldspar, anorthoclase, separated from D. Contains hematite inclusions. Analysis by J. E. Whitfield, record No. 521. Dried at 104°.

	D.	E.	F.	G.
SiO_2	72.42	74.00	73.70	65.00
Al_2O_3	13.04	12.04	12.87	18.22
Fe_2O_3	.68	.78	3.76	2.64
FeO	2.49	2.61	.31	....
MgO	.58	.42	.11	.06
CaO	.66	.85	.14	1.06
Na_2O	3.44	3.47	3.63	8.40
K_2O	4.97	4.33	4.56	4.18
H_2O	1.21	.86	.57	.46
TiO_2	.40	.34	.12	....
P_2O_5	.20	.06	trace	....
MnO	.09	.05	.07	....
SrO	trace?	trace	....	....
BaO	.15	.12	....	....
Li_2O	trace?	trace?	....	....
Cl	trace	trace	....	....
	100.33	99.93	99.84	100.02

H. Dark vitreous quartzite. Contains quartz, a little red feldspar some chlorite, some green mica, a few scales of biotite, and grains c magnetite. P. R. C. 1007.

I. Lighter interbedded quartzite. Feldspar in it much altered P. R. C. 1004.

J. Epidotic quartzite. P. R. C. 1023.

K. Unaltered quartzite. P. R. C. 1006.

Analyses by R. B. Riggs, record Nos. 569, 571, 572, 575. Materia dried at 105°.

	H.	I.	J.	K.
SiO_2	74.22	73.65	73.14	73.64
Al_2O_3	10.61	11.08	12.60	11.25
Fe_2O_3	7.45	7.24	7.57	6.24
FeO	.85	.77	1.31	1.04
MgO	1.48	1.52	1.67	1.57
CaO	.56	.40	.43	.36
Na_2O	2.12	1.67	1.78	3.04
K_2O	1.08	1.65	1.00	1.42
Ign	1.79	1.88	.83	1.98
TiO_2	.16	trace?	.04	trace
MnO	none	trace	trace	none
	100.32	99.86	100.37	100.54

Ba and Sr not looked for.

L. Altered quartzite. Contains more fibrous chlorite, some sericite, a little kalin and biotite, grains of magnetite, earthy matter, and sometimes a little calcite. Analysis by R. B. Riggs, record No. 570. P. R. C. 1009.

M. Mottled quartzite. Analysis by Riggs, record No. 573. P. R. C. 1021.

N. Purplish slate, containing many small crystals of red feldspar and scales of mica. Analysis by J. E. Whitfield, record No. 520. P. R. C. 1024.

O. Very slightly altered slate. Analysis by Riggs, record No. 576. P. R. C. 1011.

Material for analysis dried at 104°–105°.

	L.	M.	N.	O.
SiO_2	71.00	72.25	63.82	59.71
Al_2O_3	12.88	10.73	14.65	18.32
Fe_2O_3	6.69	8.01	3.16	8.11
FeO	.65	.38	5.12	.85
MgO	1.68	1.85	2.08	3.54
CaO	.21	.42	.70	1.05
Na_2O	1.43	2.03	1.95	1.93
K_2O	2.95	2.56	2.81	3.43
H_2O	2.03	2.05	2.62	3.24
TiO_2	.44	trace	2.66	trace
P_2O_5	....	....	.19	....
MnO	trace	trace	none	none
Li_2O	....	....	none	....
SO_3	....	....	.33	....
	99.96	100.28	100.09	100.18

Ba and Sr not looked for.

P. Red granitic rock resembling D, but with more dark spots, found in contact with the purplish slate, N. Consists mainly of red feldspar, quartz, and chlorite. Analysis by J. E. Whitfield, record No. 519. Dried at 104°. P. R. C. 1014.

Q. Groundmass of red mottled quartzite. Analysis by W. F. Hillebrand, record No. 499. P. R. C. 1022.

R. Green mottlings from Q. Mostly quartz and sericite. Analysis by Hillebrand, record No. 498.

S. Another sample of the green mottlings, selected with especial care. Analysis by L. G. Eakins, record No. 1058.

T. Brilliantly red vitreous quartzite. Analysis by R. B. Riggs, record No. 574. Dried at 105°. P. R. C. 1008.

	P.	Q.	R.	S.	T.
SiO_2	68.36	76.57	77.70	83.27	83.69
Al_2O_3	13.76	9.21	7.67	7.81	7.50
Fe_2O_3	2.65	1.67	3.55	1.99	1.81
FeO	2.75	3.94	3.29	1.81	.38
MgO	.68	1.51	1.83	1.59	.35
CaO	.70	.73	.26	.20	.39
Na_2O	3.56	3.07	1.96	.19	2.46
K_2O	4.48	1.02	1.04	1.11	2.61
H_2O	.98	1.89	*a* 2.36	2.32	.72
TiO_2	1.57	.42	.30	trace	trace?
P_2O_5	.33	trace	none	trace	....
ZrO_2	....	none	....	....	....
MnO	trace	.05	.04	....	trace
SrO	undet.	trace?	(?)	....	undet.
BaO	undet.	none	none	....	undet.
Li_2O	none	trace	trace	....	....
SO_3	.66	....	....	....	....
	100.48	100.08	100.00	100.29	99.91

a Determined by difference.

6. MISCELLANEOUS ROCKS FROM MINNESOTA.

A. Granulitic hypersthene-gabbro, from SE. ¼ sec. 20, T. 65 N., R. 4 W. Described by Bayley, Journal of Geology, vol. 3, p. 1. Contains hypersthene, biotite, diallage, magnetite, and plagioclase. Poor in feldspar. Analysis by H. N. Stokes, record No. 1267.

B. Hypersthene from A. Analysis by E. A. Schneider, record No. 1358.

C. Granulitic diallage-gabbro, SE. ¼ of NW. ¼ of sec. 26, T. 64 N., R. 8 W. Described by Bayley, Journal of Geology, vol. 3, p. 1. Contains diallage, hypersthene, magnetite, and plagioclase. Analysis by W. H. Melville, record No. 1403.

D. Olivine-gabbro, west side of Birch Lake, SE. ¼ of sec. 19, T. 63 N., R. 4 W. Described by Bayley, Journal of Geology, vol. 1, p. 688. Contains a large proportion of diallage and olivine. Analysis by Stokes, No. 1267.

E. Olivine from D. Analysis by W. F. Hillebrand, record No. 1308.

	A.	B.	C.	D.	E.
SiO_2	46.96	48.44	49.56	45.66	35.58
Al_2O_3	14.13	7.91	17.81	16.44	.92
Fe_2O_3	.76	.33	2.76	.66	33.91
FeO	14.95	20.88	9.48	13.90	
MgO	15.97	19.35	5.93	11.57	26.86
CaO	2.32	1.44	9.70	7.23	.90
Na_2O	.35	....	2.87	2.13	....
K_2O	1.68	....	....	.41	....
H_2O at 105°	.07	.08	.50	.07	.11
H_2O above 105°	1.26	none		.83	.20
TiO_2	.62	undet.	.48	.92	1.22
P_2O_5	.03	....	.67	.05	....
Cr_2O_3	trace	....	....	trace	trace
MnO	.93	.92	.06	trace	.35
CoO	....	....	....	....	.20
NiO	.06	....	....	.16	
CO_2	....	....	trace	....	....
	100.09	99.35	99.82	100.03	100.25

F. Average gabbro, south quarter post, sec. 35, T. 61 N., R. 12 W. Described by Bayley in Journal of Geology, vol. 1, p. 688. Contains plagioclase, olivine, pyroxene, and magnetite. Analysis by H. N. Stokes, record No. 1267.

G. Feldspar from preceding gabbro. Analysis by W. F. Hillebrand, record No. 1308.

H. Feldspar from gabbro, east side of North Fowl Lake. Analysis by Hillebrand, No 1308.

I. Feldspar from gabbro, NW. ¼ of SE. ¼ of sec. 23, T. 62 N., R. 10.

J. Feldspar from gabbro, center of sec. 25, T. 64 N., R. 8.

K. Feldspar from gabbro, Duluth and Iron Range Railroad.

Analyses I, J, and K by Hillebrand, record No. 1115.

H, I, J, and K analyzed for W. S. Bayley, but analyses hitherto unpublished.

	F.	G.	H.	I.	J.	K.
SiO_2	46.45	51.89	62.71	52.50	52.61	53.45
Al_2O_3	21.30	29.68	19.20	30.15	29.80	29.77
Fe_2O_3	.81	.32	1.08	.47	.57	.33
FeO	9.57	.37	.93	.15	.23	.15
MgO	7.90	.38	.81	.10	.20	.11
CaO	9.83	12.62	.44	12.82	12.25	11.33
Na_2O	2.14	3.87	2.96	3.72	3.80	4.33
K_2O	.34	.50	10.41	.53	.53	.68
H_2O at 100°	.14	.07	.23	.25	.29	.23
H_2O above 100°	1.02	.39	.92			
TiO_2	1.19	....	trace	trace	trace	trace
P_2O_5	.02	....	....	....	....	....
NiO	.04	....	....	....	....	....
MnO	trace	....	trace	....	trace	....
SrO	....	....	trace	....	....	....
	100.75	100.09	99.69	100.69	100.28	100.38

L. Garnetiferous gabbro, Granite Falls. Described by W. S. Bayley in Bull. 150, p. 282. Contains plagioclase, augite, garnet, magnetite, a little hornblende, some quartz grains, and apatite. Analysis by H. N. Stokes, record No. 1296. Sp. gr. 3.105. P. R. C. 109.

M. Gabbro-diorite, Minnesota Falls. Described by Bayley in Bull. 150, p. 369. Essentially plagioclase and hornblende, with some kaolin, augite, and biotite. Analysis by Stokes, No. 1296. Sp. gr. 2.935. P. R. C. 144.

N. Quartz-norite-gneiss, Odessa. Described by Bayley in Bull. 150, p. 358. Contains quartz, plagioclase, pyroxene, biotite, garnet, magnetite, and sulphide of iron. Analysis by Stokes, No. 1296. Sp. gr. 2.770.

O. Mica-schist, bed of Cross River, near Gunflint Lake. Description furnished by C. R. Van Hise. Contains biotite, quartz, feldspar (?), and pyrites. Analysis by T. M. Chatard, record No. 896.

P. Actinolite-magnetite-schist, SE. ¼ of SE. ¼ of sec. 34, T. 61 N., R. 12 W. Described by Bayley in Amer. Journ. Sci., 3d series, vol. 46, p. 178. Mainly actinolite and magnetite. Analysis by W. H. Melville, record No. 1403.

Q. Magnetite rock near the preceding, also described with P by Bayley. Analysis by Melville, No. 1403.

	L.	M.	N.	O.	P.	Q.
SiO_2	52.31	48.29	61.04	64.77	12.35	1.16
Al_2O_3	18.35	20.87	16.97	14.45	.10	1.81
Fe_2O_3	5.90	1.13	....	1.84	58.68	69.08
FeO	11.06	4.93	5.58	4.54	21.34	27.10
MgO	1.00	7.54	3.62	2.34	4.08	.25
CaO	7.33	14.32	5.99	2.33	1.91	.53
Na_2O	2.90	1.77	1.96	1.37	trace	....
K_2O	.49	.38	.55	5.03	....	....
H_2O at 105°	.35	.89	.43	.07	.19	....
H_2O above 105°				1.92		
TiO_2	....	....	....	.60	.12	none
P_2O_5	....	....	....	.20	.25	.06
MnO	....	....	....	.11	1.22	.33
SO_3	....	....	....	.60	....	....
CO_2	....	....	....	.41	....	....
FeS	....	....	a3.73	....	....	....
	99.69	100.12	99.87	100.58	100.24	100.32

a Probably pyrrhotite.

SOUTH DAKOTA.

A. Phonolite, Black Hills. Described by Whitman Cross in Bull. 150, p. 191. Contains sanidine, nephelite, ægirite, nosean, and sodalite, with accessory sphene, apatite, and zircon, and possibly some rare zirconates or titanates. Also, sparingly, secondary zeolites and calcite. No magnetite, but minute ferritic flakes are disseminated through the rock. Analysis by W. F. Hillebrand, record No. 1618. P. R. C. 73.

B. An earlier analysis of A, by H. N. Stokes, record No. 1314. This was made along the ordinary lines as regards "completeness," as requested by the collector, and without regard to minor accessory constituents. It serves well to illustrate the difference between the two modes of treatment, in comparison with the fuller analysis.

C. Tourmaline-biotite-schist, north of Harney Peak, Black Hills. Described by Bayley in Bull. 150, p. 327. Contains quartz, biotite, tourmaline, a little garnet and rarely muscovite, iron ore, and apatite. Analysis by Stokes, record No. 1296. P. R. C. 130.

	A.	B.	C.
SiO_2	57.86	58.60	66.77
Al_2O_3	20.26	20.98	17.65
Fe_2O_3	2.35	2.22	1.55
FeO	.39	.44	3.29
MgO	.04	.33	2.13
CaO	.89	1.13	.56
Na_2O	9.47	8.38	.99
K_2O	5.19	5.49	4.49
H_2O at 110°	.21	1.92	1.89
H_2O above 110°	2.40		
TiO_2	.22	....	....
P_2O_5	.03	....	....
ZrO_2	.15	....	....
MnO	.21	.20	....
SrO	.04	....	....
BaO	.09	....	....
Li_2O	trace	....	....
SO_3	.06	....	....
S	.03	....	....
Cl	.08	....	....
F	(?)	....	....
CO_2	none	....	....
	99.97	99.69	99.32

WYOMING.

Rocks studied by Whitman Cross. The Leucite Hills series is described in Amer. Jour. Sci., 4th ser., vol. 4, p. 115. Analysis J is by L. G. Eakins, record No. 1078. The others are by W. F. Hillebrand, one made in the Denver laboratory, and record Nos. 343, 355, 362, 368, 403, 463, 1668, and 1682.

A. Wyomingite, Boars Tusk, Leucite Hills. Contains phlogopite, leucite, diopside, and apatite. Sp. gr. 2.779, 13.5°. P. R. C. 567.

B. Wyomingite, Fifteenmile Spring, Leucite Hills. Composition like A. Sp. gr. 2.627, 30°. P. R. C. 566.

C. Portion of B soluble in 2.5 per cent nitric acid.

D. Phlogopite from wyomingite.

E. Madupite, Pilot Butte, Leucite Hills. Contains predominating diopside and phlogopite, with perofskite and magnetite, in a glassy base which has approximately the composition of leucite. Sp. gr. 2.857, 22°. P. R. C. 576.

	A.	B.	C.	D.	E.
SiO_2	50.23	53.70	6.08	42.56	42.65
Al_2O_3	11.22	11.16	.91	12.18	9.14
Fe_2O_3	3.34	3.10	} .50	2.73	5.13
FeO	1.84	1.21		.90	1.07
MgO	7.09	6.44	1.51	22.40	10.89
CaO	5.99	3.46	2.13	.20	12.36
Na_2O	1.37	1.67	.28	.44	.90
K_2O	9.81	11.16	1.21	10.70	7.99
H_2O at 110°	.93	.80	(?)	....	2.04
H_2O above 110°	1.72	2.61	(?)	2.35	2.18
TiO_2	2.27	1.92	.21	2.09	1.64
P_2O_5	1.89	1.75	1.54	.06	1.52
Cr_2O_3	.10	.04	....	.73	.07
Di_2O_3, etc. *a*	.03	none	....	....	.11
MnO	.05	.04	....	....	.12
SrO	.24	.19	.10	trace	.33
BaO	1.23	.62	.14	1.00	.89
Li_2O	trace	trace	....	trace	trace
SO_3	.74	.06	.06	....	.58
Cl	.03	.03	.03	....	.03
F	.50	.44	....	2.46	.47
	100.62	100.40	14.70	100.80	100.11
Less O	.22	.19	....	1.03	.20
	100.40	100.21	....	99.77	99.91

a Probably contains other rare earths.

F. Orendite, Fifteenmile Spring, Leucite Hills. Contains predominating leucite and sanidine, with phlogopite, a little biotite, diopside, and amphibole, and accessory apatite and rutile. Sp. gr. 2.686, 23.5°.

G. Orendite, North Table Butte, Leucite Hills. Composition like F. Sp. gr. 2.699, 19°.

H. Groundmass of F. Sp. gr. 2.615, 19°. Not cited in published paper.

I. Diopside separated from mixed wyomingite and madupite. Sp. gr. 3.290, 20°. Analyzed in the Denver laboratory. P_2O_5 included with TiO_2.

J. Dacite?, Garfield Peak. Phenocrysts of plagioclase and hornblende, with microscopic sphene and apatite in a groundmass containing plagioclase, orthoclase, quartz, and magnetite. Sp. gr. 2.576, 26.2°. P. R. C. 159.

	F.	G.	H.	I.	J.
SiO_2	54.08	54.17	58.13	50.86	67.78
Al_2O_3	9.47	10.16	11.72	....	16.67
Fe_2O_3	3.19	3.34	3.01	1.19	1.99
FeO	1.03	.65	1.01	1.82	.51
MgO	6.74	6.62	5.79	17.42	.71
CaO	3.55	4.19	2.24	23.32	2.67
Na_2O	1.39	1.21	1.36	.76	4.91
K_2O	11.76	11.91	12.58	.42	3.43
H_2O at 110°	.79	.52	.99	....	1.44
H_2O above 110°	2.71	1.01	1.16	.31	
TiO_2	2.08	2.67	1.48	3.03	....
P_2O_5	1.36	1.59	.32	....	.19
ZrO_2	undet.	.22	undet.	....	....
V_2O_3	.02	....	....	....	....
Cr_2O_3	.07	.05	....	....	....
NiO	....	trace	....	....	....
MnO	.05	.06	trace	.03	trace
SrO	.20	.18	.10	....	....
BaO	.67	.59	.29	....	....
Li_2O	trace	trace	trace	....	....
SO_3	.29	.16	.13	....	....
CO_2	....	.49	....	....	....
Cl	.04	.06	trace	....	....
F	.49	.36	trace	....	....
	99.98	100.21	100.31	99.16	100.30
Less O	.21	.17	....	....	....
	99.77	100.04	....	....	....

YELLOWSTONE NATIONAL PARK AND THE ABSAROKA RANGE.

1. ELECTRIC PEAK.

Rocks described by Iddings in 12th Ann., p. 577. Also in Bull. Phil. Soc. Washington, vol. 11, p. 206. For analyses O, P, see Mon. XXXII, Pt. II.

A. Pyroxene-mica-diorite. Contains augite, hypersthene, plagioclase, quartz, biotite, hornblende, magnetite, and apatite. Analysis by J. E. Whitfield, record No. 830. P. R. C. 94.

B. Pyroxene-mica-diorite. Same minerals as under A. Analysis by Whitfield, No. 921.

C. Pyroxene-mica-diorite. Like A and B. Analysis by W. H. Melville, record No. 1231.

D. Pyroxene-porphyry. Contains augite, hypersthene, biotite, magnetite, plagioclase, and quartz. Analysis by Whitfield, No. 830.

E. Quartz-pyroxene-mica-diorite. Contains biotite, hornblende, augite, hypersthene, magnetite, plagioclase, orthoclase, and quartz. Analysis by Melville, No. 1231.

	A.	B.	C.	D.	E.
SiO_2	56.28	58.05	61.22	57.38	64.07
Al_2O_3	14.23	18.00	16.14	16.86	15.82
Fe_2O_3	4.69	2.49	3.01	2.49	3.40
FeO	4.05	4.56	2.58	5.17	1.44
MgO	6.37	3.55	4.21	5.51	3.39
CaO	7.94	6.17	5.46	7.32	4.43
Na_2O	2.98	3.64	4.48	3.33	4.06
K_2O	1.23	2.18	1.87	1.45	2.27
H_2O at 100°	.93	.86	.04	.42	.10
H_2O above 100°			.40		.42
TiO_2	.84	1.05	.61	trace	.45
P_2O_5	.40	.17	.25	trace	.18
MnO	.16	none	trace	trace	trace
NiO	....	....	.09	....	.05
Li_2O	.01	none	....	.39	....
SO_3	trace	.07	....	.21	....
Cl	.17	trace	....	.17	....
	100.28	100.79	100.36	100.70	100.08

F. Quartz-mica-diorite. Contains biotite, hornblende, augite, hypersthene, plagioclase, orthoclase, and quartz. Analysis by Whitfield, No. 921.

G. Quartz-mica-diorite. Contains biotite, hornblende, plagioclase, pyroxene, quartz, and orthoclase. Analysis by Whitfield, No. 921.

H, I, J. Quartz-mica-diorites. Contain hornblende, biotite, plagioclase, orthoclase, and quartz. Analyses by Whitfield, Nos. 921 and 830.

	F.	G.	H.	I.	J.
SiO_2	65.11	65.60	64.85	66.05	67.54
Al_2O_3	16.21	17.61	16.57	16.96	17.02
Fe_2O_3	1.06	.95	2.10	2.59	2.97
FeO	3.19	2.76	2.15	1.38	.34
MgO	2.57	1.49	2.14	2.08	.13
CaO	3.97	3.72	4.01	3.37	3.36
Na_2O	4.00	4.36	3.71	4.20	4.62
K_2O	2.51	2.36	3.10	2.53	2.28
H_2O	.94	.59	.35	.69	.55
TiO_2	.71	.75	.91	.34	.80
P_2O_5	.02	.16	.14	trace	trace
MnO	none	none	none	none	trace
Li_2O	.04	.03	none	none	.03
SO_3	trace	trace	trace	.03	.26
Cl	none	none	none	trace	.15
	100.33	100.38	100.03	100.22	100.05

K. Quartz-mica-diorite-porphyry. Contains biotite, hornblende, plagioclase, orthoclase, and quartz. Analysis by Whitfield, No. 830.

L. Quartz-mica-diorite-porphyry. Contains quartz, biotite, plagioclase, alkali-feldspar, and hornblende. Analysis by Whitfield, No. 830.

M. Hornblende-porphyry; intrusive sheet. Contains hornblende, plagioclase, magnetite, and quartz. Analysis by Whitfield, No. 429.

N. Hornblende-mica-porphyry; intrusive sheet. Contains hornblende, plagioclase, biotite, magnetite, and quartz. Analysis by Whitfield, No. 420. The Indian Creek laccolith.

O. Augite-andesite-porphyry; intrusive sheet, upper portion. Contains malacolite, plagioclase, probably orthoclase, magnetite, and little biotite, with secondary chlorite or serpentine and actinolite. Analysis by Whitfield, No. 830.

P. Same sheet as O, lower portion. Analysis by W. F. Hillebrand, record No. 1571. Contains 0.04 V_2O_3.

	K.	L.	M.	N.	O.	P.
SiO_2	65.97	69.24	58.49	61.50	52.10	50.59
Al_2O_3	16.53	15.30	16.70	17.42	16.34	11.53
Fe_2O_3	2.59	1.72	3.85	4.66	3.84	1.83
FeO	1.72	.69	2.37	1.09	6.82	7.64
MgO	2.11	.95	3.12	1.26	4.33	11.27
CaO	3.37	2.98	5.90	5.33	4.73	8.79
Na_2O	3.41	4.46	3.47	3.99	4.02	2.27
K_2O	2.67	2.52	1.59	1.29	4.20	2.33
H_2O at 110°	1.23	1.30	2.44	2.44	1.74	.21
H_2O above 110°						1.76
TiO_2	.42	.65	1.71	none	.79	.80
P_2O_5	trace	trace	trace	.60	.68	.48
MnO	none	trace	.24	trace	trace	.17
NiO	....	....	....	....	....	.06
SrO	....	....	....	....	....	.03
BaO	....	....	....	....	....	.10
Li_2O	.09	none	.01	.03	.13	trace
SO_3	.13	.27	.63	.35	.22	none
Cl	.09	trace	....	....	.24	trace
	100.33	100.08	100.52	99.96	100.18	99.86
O=Cl	.02	....	....	....	.05	
	100.31	....	....	....	100.13	

2. SEPULCHRE MOUNTAIN.

Rocks described by Iddings, 12th Ann., p. 633. Also in Bull. Phil. Soc. Washington, vol. 11, p. 210, and in Mon. XXXII, Pt. II.

A. Pyroxene-andesite. Essentially composed of augite, hypersthene, and plagioclase. Analysis by J. E. Whitfield, record No. 923.

B. Pyroxene-andesite. Composition like A. Analysis by Whitfield, No. 923.

C. Hornblende-andesite. Essentially plagioclase and hornblende. Analysis by Whitfield, No. 922.

D. Hornblende-pyroxene-andesite. Contains augite, hypersthene, plagioclase, and hornblende. Analysis by T. M. Chatard, record No. 712.

E. Hornblende-pyroxene-andesite. Minerals as in D, with magnetite also. Analysis by Chatard, No. 712.

	A.	B.	C.	D.	E.
SiO_2	55.83	57.17	55.92	56.61	60.30
Al_2O_3	17.11	17.25	17.70	13.62	16.31
Fe_2O_3	4.07	2.48	3.16	5.89	4.35
FeO	3.75	4.31	4.48	2.60	1.41
MgO	5.05	4.83	4.34	5.48	2.39
CaO	7.40	6.61	5.90	6.61	5.62
Na_2O	2.94	3.44	4.08	3.13	3.99
K_2O	1.71	2.03	2.24	2.71	2.36
H_2O at 105°	1.28	1.20	1.42	1.20	.64
H_2O above 105°				1.07	1.86
TiO_2	1.05	1.03	.94	.79	.76
P_2O_5	.21	.05	.18	.06	.20
Cr_2O_3				.05	trace?
MnO	none	none	trace	.35	.13
BaO				.14	.15
SrO				Trace	Trace
Li_2O	none	trace	.09		
SO_3	trace	trace	trace	(?)	.10
Cl	none	trace	none		
	100.40	100.40	100.45	100.31	100.57

F. Hornblende-mica-andesite. Contains plagioclase, hornblende, biotite, and magnetite. Analysis by Whitfield, No. 924.

G. Hornblende-mica-andesite. Contains plagioclase, hornblende, and biotite. Analysis by Chatard, No. 712.

H. Dacite. Contains plagioclase, hornblende, biotite, and quartz. Analysis by Whitfield, No. 830.

I. Dacite. Minerals as in H. Analysis by L. G. Eakins, record No. 1135.

J. Andesite-breccia. Not in paper cited. See Mon. XXXII, Pt. II. Analysis by Chatard, No. 712. Reported by Iddings as hornblende-mica-andesite, containing hornblende, plagioclase, quartz, biotite, and a little magnetite.

	F.	G.	H.	I.	J.
SiO_2	64.27	65.50	65.66	67.49	67.95
Al_2O_3	17.84	14.94	15.61	16.18	14.98
Fe_2O_3	3.36	1.72	2.10	1.30	2.33
FeO	1.29	2.27	2.07	1.22	.95
MgO	2.00	2.97	2.46	1.34	1.42
CaO	3.42	2.33	3.64	2.68	3.98
Na_2O	3.84	5.46	3.65	4.37	4.39
K_2O	2.48	2.76	2.03	2.40	2.86
H_2O at 105°	1.32	.24	1.07	2.69	.37
H_2O above 105°		1.13			.61
TiO_2	.32	.45	1.37	.13	.45
P_2O_5	.16	.09	trace	.13	.07
MnO	none	.20	none	.08	.09
BaO	----------	.13	----------	----------	.23
SrO	----------	trace?	----------	----------	trace?
Li_2O	.03	----------	.36	----------	----------
SO_3	trace	.06	.13	----------	.11
Cl	none	----------	.12	----------	----------
	100.33	100.25	100.27	100.01	100.79

3. ABSAROKA RANGE.

1ST. CRANDALL BASIN.

Rocks described by Iddings in Mon. XXXII, Pt. II. The analyses also appeared in Bull. Phil. Soc. Washington, vol. 12, p. 204.

A. Gabbro-porphyry, Hurricane Ridge. Contains augite, plagioclase, hypersthene, biotite, magnetite, and a little olivine. Analysis by L. G. Eakins, record No. 1089.

B. Basalt flow, north side of Timber Creek. Rich in olivine, augite, and magnetite. Analysis by Eakins, No. 1087.

C. Basalt dike, ridge south of Hurricane Ridge. Like B. Contains also labradorite and a little orthoclase. Analysis by Eakins, No. 1087.

D. Mica-gabbro-porphyry, Hurricane Ridge. Contains plagioclase, augite, hypersthene, biotite, and magnetite. Analysis by Eakins, No. 1089.

E. Mica-gabbro, Hurricane Ridge. Like D, with some orthoclase and a little quartz and olivine. Analysis by Eakins, No. 1089.

F. Basalt-glass-breccia, ridge south of Indian Peak. A glass showing crystals of olivine, augite, plagioclase, and magnetite. Analysis by Eakins, No. 1087.

	A.	B.	C.	D.	E.	F.
SiO_2	51.81	52.09	52.11	53.56	53.71	53.89
Al_2O_3	15.24	17.84	16.58	16.07	18.00	18.81
Fe_2O_3	3.66	4.27	3.66	3.21	3.99	4.92
FeO	4.86	4.56	4.99	5.29	4.05	2.81
MgO	8.89	5.33	6.87	7.23	5.19	3.29
CaO	9.06	8.03	6.43	8.77	6.88	5.42
Na_2O	2.83	3.39	3.25	3.06	3.50	3.65
K_2O	2.08	1.98	3.20	1.94	3.10	2.98
H_2O	.67	1.77	1.99	.19	.55	2.99
TiO_2	.77	.39	.53	.68	.74	.49
P_2O_5	.18	.27	.63	.18	.38	.52
MnO	.08	.14	.23	.11	.24	.17
	100.13	100.06	100.47	100.29	100.33	99.94

G. Orthoclase-gabbro-diorite, rich in mica, Hurricane Ridge. Contains orthoclase, plagioclase, quartz, biotite, augite, hypersthene, magnetite, and hornblende. Analysis by Eakins, No. 1089.

H. Another sample, like G. Same analyst and record number.

I. Dioritic facies of gabbro, Hurricane Ridge. Very feldspathic. Same analyst and number.

J. Monzonite, Hurricane Ridge. Contains orthoclase, plagioclase, biotite, augite, hypersthene, and magnetite. Analysis by W. H. Melville, record number 1233.

K. Augite-andesite-porphyry, intrusive sheet, Hurricane Ridge. Analysis by Eakins, No. 1088. Contains plagioclase, augite, hypersthene, magnetite, biotite, quartz, and microscopic orthoclase.

	G.	H.	I.	J.	K.
SiO_2	55.93	56.21	57.26	57.32	57.64
Al_2O_3	18.32	18.24	19.40	17.29	18.43
Fe_2O_3	2.39	3.26	2.49	3.89	3.63
FeO	4.91	3.69	3.29	3.03	2.84
MgO	3.97	3.38	2.57	3.56	3.32
CaO	6.17	5.91	5.68	5.81	5.49
Na_2O	4.29	4.15	4.21	3.89	4.03
K_2O	2.62	3.02	2.95	3.04	3.33
H_2O at 100°	.22	.78	.86	.33	.51
H_2O above 100°				.30	
TiO_2	.81	.88	.76	.62	.77
P_2O_5	.56	.64	.51	.50	.34
MnO	.14	.17	.16	.06	.10
NiO	....	....	....	.10	....
Cl	....	....	....	....	trace
	100.33	100.33	100.14	99.74	100.43

L. Hornblende-mica-andesite-porphyry dike, ridge south of Hurricane Ridge. Contains plagioclase, hornblende, biotite, augite, hypersthene, and magnetite, with a little chlorite or serpentine. Analysis by Eakins, No. 1087.

M. Quartz-diorite-porphyry, Hurricane Ridge. Contains plagioclase, orthoclase, quartz, augite, hypersthene, magnetite, and a little biotite. Analysis by Melville, No. 1234.

N. Quartz-mica-diorite, Hurricane Ridge. Contains andesine, orthoclase, quartz, biotite, hornblende, magnetite, and a little pyroxene. Analysis by Melville, No. 1234.

O. Quartz-mica-diorite-porphyry, Hurricane Ridge. Contains andesine, orthoclase, quartz, and biotite. Analysis by Melville, No. 1234.

P. Aplite dike, Hurricane Ridge. Contains quartz, orthoclase, oligoclase, biotite, magnetite, some chlorite, and a little hornblende. Analysis by Eakins, No. 1088.

	L.	M.	N.	O.	P.
SiO_2	61.16	63.42	63.97	64.40	71.62
Al_2O_3	16.17	17.16	15.78	15.77	14.99
Fe_2O_3	2.89	3.09	2.35	2.47	1.27
FeO	2.18	1.50	1.87	1.15	1.01
MgO	3.89	1.64	2.84	2.12	.74
CaO	4.26	4.65	3.71	3.54	1.33
Na_2O	3.87	4.51	4.36	4.10	3.62
K_2O	3.20	3.04	4.01	3.81	4.81
H_2O at 100°	2.09	.16	.09	.31	.41
H_2O above 100°		.28	.49	1.93	
TiO_2	.23	.35	.48	.40	.08
P_2O_5	.13	.26	.40	.16	trace
MnO	trace	.04	.05	.04	.17
NiO	....	.19	trace	.17	....
Cl	....	....	....	....	trace
	100.07	100.29	100.40	100.27	100.05

2D. SUNLIGHT INTRUSIVES.

Descriptions, hitherto unpublished, supplied by Arnold Hague and T. A. Jaggar, jr. Analyses A, B, and C by W. F. Hillebrand, record No. 1801; D by H. N. Stokes, No. 1804.

A. Quartz-syenite, Copper Creek Basin. Contains biotite, hornblende, epidote, orthoclase, augite, titanite, magnetite, and apatite. Hornblende very pale in color.

B. Syenite-porphyry, Sulphur Creek Basin. Contains oligoclase and biotite, in a groundmass of quartz and feldspar.

C. Augite-syenite-porphyry, Copper Creek Basin. Contains augite, biotite, orthoclase, a little hornblende, and quartz.

D. Gabbro, southwest of Beams Hill, Sunlight Valley. Contains plagioclase, pyroxene, magnetite, apatite, and a little biotite.

	A.	B.	C.	D.
SiO_2	63.07	66.64	64.40	53.57
Al_2O_3	17.47	16.22	16.90	17.78
Fe_2O_3	2.09	1.84	1.86	3.19
FeO	1.38	1.06	1.37	4.93
MgO	1.44	1.25	1.13	4.36
CaO	2.27	2.41	2.60	6.22
Na_2O	5.77	5.11	5.79	4.04
K_2O	4.59	3.86	4.56	3.04
H_2O at 110°	.25	.52	.16	.27
H_2O above 110°	.43	.55	.39	.80
TiO_2	.38	.29	.23	.89
P_2O_5	.18	.16	.21	.44
ZrO_2	trace	.01	.02	----------
Cr_2O_3	trace	trace	?	none
V_2O_3	trace	.01	?	----------
NiO	none	none	none	none
MnO	.03	trace	.07	.07
SrO	.15	.14	.14	.13
BaO	.32	.27	.27	.21
Li_2O	trace?	none	trace	trace
CO_2	none	none	none	none
FeS_2	.02	trace?	trace?	----------
	99.84	100.34	100.10	99.94

3D. ISHAWOOA INTRUSIVES.

Descriptions, hitherto unpublished, supplied by Arnold Hague and T. A. Jaggar, jr. Analyses A and B by H. N. Stokes, record No. 1804; C and D by W. F. Hillebrand, No. 1765.

A. Granite-porphyry, base of Crater Mountain. Contains oligoclase, orthoclase, biotite, and quartz.

B. Diorite-porphyry, Cabin Creek. Contains plagioclase, orthoclase, quartz, and abundant hornblende. This rock is intermediate between granite-porphyry and diorite-porphyry, but nearer to the latter.

C. Diorite, base of Needle Mountain. Contains plagioclase, quartz, biotite, with subordinate hornblende and orthoclase. Structure granitic.

D. Diabase, entrance to Shoshone Canyon. Contains plagioclase, augite, and chlorite.

	A.	B.	C.	D.
SiO_2	64.23	60.00	63.76	52.18
Al_2O_3	16.34	16.37	16.01	18.19
Fe_2O_3	1.07	2.28	2.22	3.31
FeO	1.58	2.46	1.96	4.36
MgO	2.47	3.81	2.43	4.69
CaO	3.07	4.96	4.55	6.51
Na_2O	3.49	3.73	3.98	4.58
K_2O	2.59	2.70	2.84	1.88
H_2O at 110°	.47	.61	.28	.75
H_2O above 110°	1.76	1.42	.57	2.00
TiO_2	.50	.59	.52	.99
P_2O_5	.18	.35	.25	.29
NiO	none	none	none	trace
MnO	trace	.05	.09	.14
SrO	.06	.11	.09	.06
BaO	.19	.26	.17	.11
Li_2O	trace	trace	trace	trace
CO_2	.30	.17	.23	none
Cl	....	....	trace	trace
S	....	....	(?)	none
FeS_2	1.61	....	....	....
	99.91	99.87	99.95	100.04

4. DIKES IN BRECCIA.

Descriptions, hitherto unpublished, supplied by Arnold Hague and T. A. Jaggar, jr. Analyses A, B, D, by H. N. Stokes, record No. 1804; C, E, F, G, H, by W. F. Hillebrand, Nos. 1765 and 1801.

A. Hornblende-pyroxene-andesite, Eagle Creek. Contains plagioclase, hornblende, pyroxene, quartz, and apatite.

B. Leucite-absarokite, Sunlight Valley. Contains phenocrysts of olivine and augite, with secondary alteration of the olivine to serpentine. The groundmass contains magnetite, augite, plagioclase, and orthoclase. Leucite abundant.

C. Gabbro-porphyry, Deer Creek. Contains plagioclase, pyroxene, olivine, ilmenite, and apatite.

D. Hornblende-augite-andesite, Wind River Plateau. Contains phenocrysts of augite, hypersthene, and hornblende, plagioclase, and fine magnetite grains.

	A.	B.	C.	D.
SiO_2	50.72	47.32	50.29	60.15
Al_2O_3	16.01	11.22	15.85	17.85
Fe_2O_3	4.35	2.91	8.22	2.00
FeO	4.20	5.81	1.43	2.02
MgO	7.06	15.96	4.65	3.26
CaO	9.02	7.11	7.71	5.48
Na_2O	2.92	1.88	2.98	3.95
K_2O	1.13	3.79	3.53	2.36
H_2O at 110°	.40	.31	1.77	.25
H_2O above 110°	2.14	1.71	1.98	1.24
TiO_2	1.08	.75	.96	.47
P_2O_5	.29	.61	.51	.22
ZrO_2	....	....	....	....
Cr_2O_3	none	trace	....	none
V_2O_3	....	....	....	....
NiO	none	trace	trace	none
MnO	.07	.11	.15	.07
SrO	.09	.05	.09	.10
BaO	.11	.22	.15	.20
Li_2O	trace	trace	trace	none
CO_2	.85	.13	none	none
Cl	....	....	trace	....
FeS_2	....	....	....	....
	100.44	99.89	100.27	99.62

E. Augite-andesite, Dike Mountain. Contains augite, plagioclase serpentinized olivine, magnetite, and apatite.

F. Trachyte-andesite, Dike Mountain. Contains plagioclase, ortho clase, chlorite, apatite, and magnetite. Very little augite.

G. Biotite-trachyte, Dike Mountain. Contains plagioclase, ortho clase, biotite, magnetite, and chlorite.

H. Biotite-trachyte, Dike Mountain. Contains orthoclase, plagio clase, biotite, and magnetite.

	E.	F.	G.	H.
SiO_2	51.17	52.47	63.24	57.73
Al_2O_3	16.14	18.23	17.98	18.93
Fe_2O_3	4.11	3.31	2.67	1.97
FeO	4.48	3.85	.85	1.92
MgO	4.82	2.85	.63	.91
CaO	7.72	4.56	.93	2.78
Na_2O	2.99	4.83	6.27	5.52
K_2O	3.54	3.81	5.47	6.11
H_2O at 110°	.63	.68	.37	.22
H_2O above 110°	2.24	2.03	.80	2.93
TiO_2	1.01	.97	.38	.33
P_2O_5	.48	.64	.22	.25
ZrO_2	none	.02	trace	trace
Cr_2O_3	trace	trace	none	trace
V_2O_3	.04	.03	.01	.01
NiO	.01	trace	none	trace ?
MnO	.21	.15	.04	.06
SrO	.10	.11	.03	.09
BaO	.20	.23	.25	.16
Li_2O	trace	trace	trace	trace
CO_2	none	1.01	none	.26
FeS_2	.05	.04	trace	.02
	99.94	99.82	100.14	100.20

4. ABSAROKITE—SHOSHONITE—BANAKITE SERIES.

Rocks from the Yellowstone Park and the Absaroka Range, described in Mon. XXXII, Pt. II, and also by Iddings in Journal of Geology, vol. 3, pp. 938, 943, 947. The rock A, from Ishawooa Canyon, is also described by Hague in Amer. Journ. Sci., 3d series, vol. 38, p. 46.

A. Leucite-absarokite, Ishawooa Canyon, Wyoming. Bowlder. Contains olivine and augite in a groundmass of orthoclase and leucite. Accessory minerals, magnetite, apatite, and a few flakes of brown mica. Analysis by J. E. Whitfield, record No. 1057. Material dried at 104°.

B. Absarokite dike, head of Lamar River. Contains olivine and augite in a groundmass of orthoclase and plagioclase, with accessory magnetite, biotite, and ilmenite.

C. Absarokite dike, south of Clark Fork. Contains augite, quartz, biotite, magnetite, orthoclase, plagioclase, and sometimes analcite.

D. Absarokite lava flow, head of Raven Creek. Contains olivine, augite, orthoclase, labradorite, magnetite, apatite, and a little serpentine.

E. Absarokite dike, divide east of Cache Creek. Contains orthoclase, plagioclase, augite, biotite, magnetite, serpentine, and occasional quartz.

Analyses B, C, D, and E by L. G. Eakins, record Nos. 1086, 1365.

	A.	B.	C.	D.	E.
SiO_2	47.28	48.95	48.36	51.76	49.71
Al_2O_3	11.56	12.98	12.42	12.36	13.30
Fe_2O_3	3.52	3.63	5.25	4.88	4.41
FeO	5.71	4.68	2.48	4.60	3.37
MgO	13.17	11.73	9.36	9.57	7.96
CaO	9.20	7.66	8.65	7.14	8.03
Na_2O	2.73	2.31	1.46	1.99	1.49
K_2O	2.17	3.96	3.97	3.83	4.81
H_2O	2.96	3.16	5.54	3.05	4.07
TiO_2	.88	.49	1.18	.47	1.57
P_2O_5	.59	.67	.84	.56	.66
Cr_2O_3	----------	----------	trace	----------	trace
MnO	.13	.13	.13	.11	.17
BaO	----------	----------	.29	----------	.46
Cl	.18	----------	----------	----------	----------
	100.08	100.35	99.93	100.32	100.01
O=Cl	.04				
	100.04				

F. Shoshonite lava sheet, Lamar River, south of Bison Peak. Contains plagioclase, orthoclase, augite, olivine, magnetite, and serpentine, with amygdules of zeolite and calcite. Analysis by Eakins, No. 1086.

G. Shoshonite lava sheet, southeast fork of Beaverdam Creek. Contains plagioclase, orthoclase, augite, and serpentinized olivine.

H. Leucite (?) shoshonite lava sheet, mountain east of Pyramid Peak. Contains feldspars, olivine, serpentine, augite, magnetite, brown mica, and impure leucite (?).

I. Olivine-free shoshonite dike, northeast of Indian Peak. Contains augite, plagioclase, biotite, and magnetite.

J. Shoshonite lava sheet, Two Ocean Pass. Contains orthoclase, serpentinized olivine, magnetite, augite, chlorite, biotite, apatite, labradorite. Dried at 104°.

Analyses G, H, I by Eakins, Nos. 1371, 1375, 1379. Analysis J by Whitfield, No. 906.

	F.	G.	H.	I.	J.
SiO_2	50.06	53.49	52.49	54.86	56.05
Al_2O_3	17.00	17.19	17.89	17.28	19.70
Fe_2O_3	2.96	4.73	5.76	4.08	3.74
FeO	5.42	3.25	2.08	2.28	2.32
MgO	3.61	4.42	3.49	4.19	2.51
CaO	8.14	6.34	7.01	5.42	4.34
Na_2O	3.53	3.23	3.18	3.94	3.29
K_2O	3.40	3.86	3.73	3.96	4.44
H_2O	4.85	2.17	2.63	2.16	1.86
TiO_2	.51	.71	.81	.69	.98
P_2O_5	.66	.43	.55	.48	.66
MnO	.14	.14	.09	.19	trace
BaO	....	.06	.30	.37	....
Li_2O	....	....	....	....	.06
SO_3	....	....	....	....	.19
	100.28	100.02	100.01	99.90	100.14

K. Banakite dike, head of Lamar River. Contains augite, serpentinized olivine, orthoclase, plagioclase, biotite, magnetite, ilmenite, apatite, and analcite. Adjoins rock B. Analyses by Eakins, No. 1375.

L. Banakite dike, Hoodoo Mountain. Like K, but with amygdaloidal zeolites. Analysis by Eakins, No. 1371.

M. Banakite dike, Ishawooa Canyon, Wyoming. Like K and L, but more feldspathic. Contains a little serpentine, probably from olivine; also possibly analcite or sodalite. Analysis by Eakins, No. 1086.

N. Banakite dike, near head of Stinkingwater River. Like M, but with more serpentine. Analysis by W. H. Melville, record No. 1232.

	K.	L.	M.	N.
SiO_2	51.82	52.63	51.46	52.33
Al_2O_3	16.75	16.87	18.32	18.70
Fe_2O_3	4.56	4.52	4.61	4.95
FeO	3.36	3.11	2.71	1.83
MgO	4.03	3.69	2.91	2.69
CaO	4.94	4.77	6.03	4.71
Na_2O	3.91	3.86	4.11	4.51
K_2O	5.02	5.17	4.48	5.45
H_2O at 100°				.74
H_2O above 100°	3.97	3.65	3.89	2.71
TiO_2	.71	.81	.83	.71
P_2O_5	.52	.63	.86	.81
MnO	.23	.10	.17	.03
NiO				.14
BaO	.26	.29		
	100.08	100.10	100.38	100.31

O. Leucite-banakite lava sheet, southeast fork of Beaverdam Creek. Overlies rock G. Contains olivine, augite, leucite, feldspars, magnetite, apatite, and a little brown mica. Analysis by Eakins, No. 1378.

P. Earlier unpublished analysis of O, another sample, by J. E. Whitfield, record No. 907.

Q. Quartz-banakite dike, near head of Stinkingwater River. Contains plagioclase, orthoclase, quartz, biotite, magnetite, augite, and a little calcite. Analysis by Melville, No. 1232.

R. Quartz-banakite dike, near Q. Contains plagioclase, orthoclase, quartz, biotite, magnetite, augite, chlorite, and serpentine. Analysis by Melville, No. 1232.

	O.	P.	Q.	R.
SiO_2	52.93	51.56	57.29	60.89
Al_2O_3	19.67	21.00	18.45	17.14
Fe_2O_3	3.07	5.17	4.38	3.32
FeO	3.50	2.76	1.20	.95
MgO	2.88	2.52	2.08	1.16
CaO	4.69	4.83	3.57	3.58
Na_2O	4.20	4.37	4.43	4.54
K_2O	4.75	4.13	5.43	5.71
H_2O at 100°	2.73	2.27	.17	.39
H_2O above 100°			2.01	1.22
TiO_2	.72	.65	.72	.49
P_2O_5	.59	.69	.46	.27
MnO	.15	trace	trace	.09
NiO			.12	.19
BaO	.21			
Li_2O		.13		
SO_3		.21		
Cl		trace		
	100.09	100.29	100.31	99.94

S. Absarokite, Two Ocean Pass. Contains augite, olivine, orthoclase, magnetite, serpentine, little biotite, apatite, and an isotropic substance, probably glass. Analysis by J. E. Whitfield, record No. 906,

T. Shoshonite, Beaverdam Creek. Analysis by Whitfield, No. 907. Probably the rock already represented by analysis G.

U. Shoshonite, northeast spur of Sepulchre Mountain. Contains augite and serpentinized olivine, in a groundmass of plagioclase, orthoclase, augite, magnetite, and apatite. Analysis by Whitfield, No. 908.

V. Shoshonite, Baldy Mountain, Bear Gulch, Montana. Contains hypersthene, augite, olivine, plagioclase, orthoclase, and magnetite. Analysis by Whitfield, No. 909.

	S.	T.	U.	V.
SiO_2	51.68	52.86	51.75	54.97
Al_2O_3	14.07	17.51	17.48	18.38
Fe_2O_3	4.71	5.18	6.42	3.06
FeO	4.57	3.31	1.46	4.22
MgO	7.72	4.18	4.05	2.38
CaO	6.65	6.51	8.20	5.43
Na_2O	2.45	3.22	3.33	3.45
K_2O	4.16	3.41	3.72	3.37
H_2O	2.09	1.76	2.26	.82
TiO_2	1.08	1.04	.86	.97
P_2O_5	.72	.53	.67	.42
MnO	trace	trace	trace	trace
Li_2O	trace	.04	trace	.03
SO_3	.13	.22	.17	.03
Cl	......	.16	trace	trace
CO_2	......	......	......	2.92
	100.03	99.93	100.37	100.45

5. MISCELLANEOUS ROCKS. FIRST GROUP.

Collected and investigated by Arnold Hague and J. P. Iddings.

A. Black obsidian, Obsidian Cliff. Described by Iddings, 7th Ann. Contains microlites of augite and magnetite, with traces of quartz and feldspar. Analysis by J. E. Whitfield, record No. 224.

B. Red obsidian, Obsidian Cliff. Described by Iddings, 7th Ann. Like A, with ferric oxide replacing magnetite. Analysis by Whitfield, No. 223.

C. Obsidian, east of Willow Park. Black and opaque. Described by Iddings, Bull. Phil. Soc. Washington, vol. 12, p. 204. Analysis by Whitfield, No. 222.

D. Lithoidite, Obsidian Cliff. Described by Iddings, Bull. 150, p. 153. Contains quartz and sanidine, with a little magnetite and augite. Analysis by Whitfield, No. 425.

E. Rhyolite, Upper Geyser Basin. See Iddings, Bull. Phil. Soc. Washington, vol. 12, p. 204. Analysis by F. A. Gooch, record No. 114.

F. Rhyolite, Tower Creek. See Iddings, Bull. Phil. Soc. Washington, vol. 12, p. 204. Analysis by Gooch, No. 115.

	A.	B.	C.	D.	E.	F.
SiO_2	74.70	75.52	72.59	75.50	70.92	71.85
Al_2O_3	13.72	14.11	13.47	13.25	13.24	13.17
Fe_2O_3	1.01	1.74	1.58	1.02	3.54	2.17
FeO	.62	.08	1.32	.91	.66	1.34
MgO	.14	.10	1.05	.07	.23	.63
CaO	.78	.78	2.12	.90	1.42	2.25
Na_2O	3.90	3.92	4.63	4.76	4.28	4.06
K_2O	4.02	3.63	2.52	2.85	4.25	3.89
H_2O	.62	.39	.18	.41	.57	.43
TiO_2	none	none	.52	none	.16	.43
P_2O_5	none	....	....	none	.18	.14
MnO	trace	none	none	none	.14	.12
Li_2O	....	....	....	.06	none	....
SO_3	....	....	....	.32	....	....
FeS_2	.40	.11	.26	....	....	....
	99.91	100.38	100.24	100.05	100.59	100.48

G. Rhyolite, "Great Paint Pots." Analysis by Gooch, No. 113, hitherto unpublished.

H. Rhyolite, "Elephants Back." Porphyritic obsidian. Analysis by Whitfield, No. 423, hitherto unpublished. Reported by Iddings as containing quartz, sanidine, and a little augite and magnetite, in a glassy, microlitic groundmass.

I. Rhyolite, Mount Sheridan. Composition reported by Iddings as quartz and sanidine, with a little magnetite and augite. Analysis by Whitfield, No. 426, hitherto unpublished.

J. Rhyolite, Madison Plateau. Like I. Analysis by Whitfield, No. 427, not yet published.

K. Trachytic rhyolite, Elk Creek. Analysis by Whitfield, No. 428, hitherto unpublished. Reported by Iddings as containing sanidine, labradorite, and little biotite, in a groundmass of quartz and alkali feldspar

	G.	H.	I.	J.	K.
SiO_2	75.71	75.34	75.89	75.19	64.65
Al_2O_3	11.11	12.51	12.27	13.77	17.80
Fe_2O_3	1.56	.42	1.12	.61	2.33
FeO	.37	1.55	1.37	1.37	2.10
MgO	.08	.32	.29	.09	.81
CaO	.88	1.07	.86	.68	1.73
Na_2O	4.64	3.31	3.23	3.83	4.18
K_2O	4.18	4.17	3.42	3.33	2.83
H_2O	.35	.86	.82	.65	3.06
TiO_2	1.25	none	.50	none	trace
P_2O_5	....	none	none	none	trace
MnO	.07	.07	none	trace	trace
Li_2O	....	trace	.01	.02	.17
SO_3	....	.42	.28	.29	.43
	100.20	100.04	100.06	99.83	100.09

L. Trachytic rhyolite-tuff, Two Ocean Pass. Analysis by Whitfield, No. 906, hitherto unpublished. Reported by Iddings as containing sanidine, labradorite, biotite, magnetite, and augite, in a somewhat altered, glassy groundmass. Also contains fragments of andesite.

M. Glassy trachyte, approaching rhyolite, Sunset Peak, Bear Gulch. Contains phenocrysts of sanidine, plagioclase, and biotite. See Iddings, Bull. Phil. Soc. Washington, vol. 12, p. 205; also Mon. XXXII, Pt. II. Analysis by L. G. Eakins, record No. 1378.

N. Altered rhyolite, "Iron Pot," Lower Basin. Collected by W. H. Weed. Analysis by Whitfield, No. 546, hitherto unpublished.

O. Dacite-porphyry, Echo Peak.

P. Same as O, Mount Holmes. Analyses O and P by Whitfield, Nos. 421, 422, hitherto unpublished. Reported by Iddings as containing plagioclase, probably oligoclase, quartz, little biotite, and magnetite.

	L.	M.	N.	O.	P.
SiO_2	61.15	69.45	89.20	74.51	69.54
Al_2O_3	15.70	14.92	2.39	14.83	17.95
Fe_2O_3	4.31	3.16	1.21	1.09	2.50
FeO	1.12	.23	none	trace	.22
MgO	3.04	.05	trace	.47	.50
CaO	2.84	1.19	trace	.81	1.80
Na_2O	1.54	3.19	1.11	4.38	4.30
K_2O	2.22	5.95	.79	2.72	1.21
H_2O	7.05	1.69	5.09	.92	1.96
TiO_2	.69	.19	none	none	none
P_2O_5	.75	.06	none	trace	none
MnO	trace	.07	....	none	none
BaO	....	.03	....	....	....
Li_2O	none	....	....	.02	trace
SO_3	.18	....	.44	.24	.37
	100.59	100.18	100.23	99.99	100.35

Q. Mica-dacite-porphyry, Bunsen Peak. Analysis by Whitfield, No. 419, hitherto unpublished. Reported by Iddings as containing oligoclase-andesine, quartz, biotite, little magnetite, apatite, and zircon.

R. Mica-dacite-porphyry, Birch Hills. Like Q in composition. Analysis by Whitfield, No. 718, hitherto unpublished.

S. Hornblende-mica-andesite-porphyry, Fan Creek. Analysis by Whitfield, No. 713, hitherto unpublished. Reported by Iddings as containing andesine-oligoclase, hornblende, and biotite, in a groundmass of feldspar (probably oligoclase and orthoclase), with a little magnetite, biotite, and hornblende.

T. Hornblende-mica-andesite-porphyry, Gray Peak. Analysis by Whitfield, No. 715, hitherto unpublished. Composition similar to that of S.

	Q.	R.	T.	S.
SiO_2	70.52	70.24	65.63	65.64
Al_2O_3	15.85	17.36	17.00	17.29
Fe_2O_3	2.28	1.38	2.55	3.07
FeO	.36	.79	1.19	1.29
MgO	.09	.53	2.03	1.78
CaO	2.59	2.74	3.48	1.98
Na_2O	3.93	3.69	4.42	5.77
K_2O	3.43	2.65	1.64	2.44
H_2O	.35	.71	2.00	1.03
TiO_2	trace	trace	trace	none
P_2O_5	.17	trace	.07	.23
MnO	.09	none	none	trace
Li_2O	trace	none	.04	.04
SO_3	.29	trace	trace	trace
Cl	....	none	trace	trace
CO_2	....	none	.27	.17
	99.95	100.09	100.32	100.73

U. Hornblende-mica-andesite, Crescent Hill. Analysis by Whi field, No. 432, hitherto unpublished. Reported by Iddings as co taining oligoclase-andesine, biotite, and subordinate decompose hornblende, in a groundmass of feldspar and quartz, with a littl magnetite and biotite.

V. Hornblende-andesite, Tower Creek. Analysis by Gooch, N 117, hitherto unpublished. Reported by Iddings as containing plagi clase, hornblende, and a little augite.

W. Pyroxene-andesite, Agate Creek. Analysis by Whitfield, N 432, hitherto unpublished. Reported by Iddings as containing augit hypersthene, labradorite, and magnetite, in a glassy, microliti groundmass.

X. Rhyolitic perlite, described by Iddings, Bull. 150, p. 15 Analysis by H. N. Stokes, No. 1314, hitherto unpublished. From bluff opposite the Midway Geyser Basin. Reported by Iddings a containing quartz, sanidine, plagioclase, and rarely augite and mag netite, with microscopic zircon and apatite, in a glassy groundmass P. R. C. 61.

	U.	V.	W.	X.
SiO_2	64.61	61.56	61.45	73.84
Al_2O_3	18.62	14.73	15.07	12.47
Fe_2O_3	2.78	4.47	4.46	.32
FeO	.95	1.23	1.18	.90
MgO	.85	3.57	3.02	.25
CaO	4.20	4.87	5.37	1.08
Na_2O	4.37	5.10	4.00	2.88
K_2O	2.36	2.24	1.22	5.38
H_2O	.93	1.42	1.23	2.76
TiO_2	none	.87	2.80	....
P_2O_5	.30	.04	trace	....
MnO	trace	.34	none	trace
Li_2O	.01	....	.05	....
SO_3	trace	....	.29	....
Cl	trace	....	....	....
CO_2	.25	....	....	....
	100.23	100.44	100.14	99.88

MISCELLANEOUS ROCKS. SECOND GROUP.

Collected and investigated by Arnold Hague and J. P. Iddings.

A. Pyroxene-andesite, west of Dunraven Peak. Analysis by F. A. Gooch, record No. 116, hitherto unpublished. Reported by Iddings as containing labradorite, augite, hypersthene, and magnetite, in a microlitic groundmass.

B. Basalt, southwest of Dunraven Peak. Analysis by Gooch, No. 118, hitherto unpublished. Reported by Iddings as containing augite, olivine, labradorite-bytownite, and magnetite, in a globulitic glassy groundmass.

C. Basalt, north spur of Prospect Peak. Analysis by J. E. Whitfield, record No. 431, hitherto unpublished. Reported by Iddings as containing labradorite, augite, olivine, and magnetite. Little glass in groundmass.

D. Basalt, Yellowstone Canyon. Analysis by Whitfield, No. 430, hitherto unpublished. Reported by Iddings as containing labradorite-bytownite, augite, olivine, magnetite, and a little brown glass.

E. Basalt, Stinkingwater Canyon. See Iddings, Bull. Phil. Soc. Washington, vol. 12, p. 205. Analysis by W. H. Melville, record No. 1232.

	A.	B.	C.	D.	E.
SiO_2	56.47	51.70	47.17	51.70	52.37
Al_2O_3	15.33	15.18	17.85	17.90	16.57
Fe_2O_3	2.54	2.09	7.42	7.24	6.34
FeO	4.53	8.54	1.18	1.00	2.35
MgO	5.08	8.18	6.54	2.77	5.27
CaO	6.93	8.73	10.12	6.94	8.54
Na_2O	3.81	2.31	2.94	4.17	2.99
K_2O	1.66	1.81	.56	1.62	2.45
H_2O at 100°	1.65	.16	.65	1.15	1.18
H_2O above 100°					1.04
TiO_2	.99	1.24	2.13	3.17	.73
P_2O_5	.54	.21	.20	.41	.31
Fe, metal	....	....	3.26	1.81	....
MnO	.18	trace	none	trace	.07
NiO	....	....	....	....	.12
Li_2O	....	....	.02	.03	....
SO_3	....	....	.51	.32	....
S	....	.09	....	....	....
Cl	....	trace	....	....	....
	99.71	100.24	100.55	100.23	100.33

F. Camptonite (?), dike in Stinkingwater Canyon. See Iddings, Bull. Phil. Soc. Washington, vol. 12, p. 205. Analysis by Melville. No. 1232.

G. Kersantite, Bighorn Pass. Described by Iddings in Mon. XXXII, Pt. II. Contains hornblende, plagioclase, orthoclase, quartz, augite, biotite, magnetite, chlorite, calcite, and apatite. Augite and hornblende partly decomposed. Analysis by Whitfield, No. 714.

H. Basalt, dike, north spur of Mount Washburn. Analysis by Whitfield, No. 717, hitherto unpublished. Reported by Iddings as approaching pyroxene-andesite in composition. Contains labradorite, augite, serpentinized olivine, and magnetite, in a groundmass of globulitic and microlitic brown glass.

	F.	G.	H.
SiO_2	50.99	48.73	53.75
Al_2O_3	15.62	11.92	20.75
Fe_2O_3	8.47	4.79	4.50
FeO	1.43	4.56	3.53
MgO	5.23	5.93	3.76
CaO	6.53	9.24	7.18
Na_2O	3.39	2.62	4.16
K_2O	3.05	2.47	1.37
H_2O at 100°	1.39	} 1.52	} 1.55
H_2O above 100°	2.48		
TiO_2	.67	1.34	none
P_2O_5	.53	.32	.15
MnO	trace	.36	trace
NiO	.07	....	....
BaO	....	trace	....
Li_2O	....	trace	trace
SO_3	....	.34	trace
Cl	....	.11	none
CO_2	....	5.80	none
	99.85	100.05	100.70

MONTANA.

1. MADISON AND GALLATIN VALLEYS.

Rocks collected by A. C. Peale and G. P. Merrill. Described by Merrill in Proc. U. S. National Museum, vol. 17, p. 637. See also Bull. 110, p. 47.

A. Basalt?, east side of Bozeman Creek, 2½ miles southeast of Bozeman. Contains olivine and augite, chloritized and serpentinized. The colorless groundmass contains apparently two feldspars and a pyroxene, with grains of iron oxide. Analysis by T. M. Chatard, record No. 517. Sp. gr. 2.86. P. R. C. 971.

B. Pyroxene from A. Analysis by L. G. Eakins, record No. 1046.

C. Portion of A soluble in hydrochloric acid. Contains olivine, iron oxides, and decomposition products. Analysis by Eakins, record No. 817.

	A.	B.	C.
SiO_2	46.90	52.50	20.88
Al_2O_3	10.17	2.26	3.89
Fe_2O_3	1.22	2.05	2.21
FeO	5.17	2.47	4.28
MgO	20.98	17.11	16.44
CaO	6.20	21.70	1.01
Na_2O	1.16	.35	trace
K_2O	2.04	.07	trace
H_2O at 120°	1.04	} .64	
H_2O above 120°	4.38		....
TiO_2	.41	....	....
P_2O_5	.44	....	....
Cr_2O_3	.33	1.07	....
MnO	.10	trace	trace
	100.54	100.32	48.71

D. Highly altered porphyrite?, hills 1 mile north of East Gallatin River, near camp No. 6. Rock contains hornblende paramorphs after augite in a devitrified base, with amygdules of calcite, chloritic and ferruginous matter derived from porphyritic augite and olivine. The base is also filled with needles, which may be mica. Analysis by Eakins, record No. 820. P. R. C. 968.

E. Lamprophyre, Cottonwood Creek. Contains porphyritic augite and olivine in an indeterminate groundmass carrying augite, iron oxides, and mica. Analysis by Chatard, record No. 516. P. R. C. 979.

F. Augite-porphyry, Cottonwood Creek. Contains feldspars, augite, and brown mica, with iron oxides, apatite, glass, and secondary calcite and chlorite. Carries porphyritic plagioclase and augite. No unaltered olivine visible. Sp. gr. 2.785. Analysis by Eakins, record No. 819. P. R. C. 965.

	D.	E.	F.
SiO_2	49.47	51.65	52.33
Al_2O_3	12.15	13.89	15.09
Fe_2O_3	1.93	2.70	4.31
FeO	4.07	4.80	4.03
MgO	10.86	11.56	6.73
CaO	9.30	4.07	7.06
Na_2O	2.08	2.99	3.14
K_2O	2.42	4.15	3.76
H_2O at 120°	4.14	1.30	2.68
H_2O above 120°		1.89	
TiO_2	.21	.55	.14
P_2O_5	.37	.21	1.02
Cr_2O_3	trace	.08	....
MnO	.10	.15	.09
BaO	.03	.19	.07
SO_3	....	.19	....
CO_2	3.31	....	....
	100.44	100.37	100.45

G. Basalt?, Bear Creek. Resembles A, but with a more crystalline groundmass. Contains plagioclase, possibly sanidine, augite, olivine, and iron oxides. Analysis by Chatard, record No. 1154. P. R. C. 967.

H. Lamprophyre, between South Boulder and Antelope creeks. Contains porphyritic augite and olivine in a feldspathic groundmass, with apatite, augite, grains of iron oxide, and shreds of brown mica. Sp. gr. 2.96. Analysis by Eakins, record No. 1266. P. R. C. 966.

I. Lamprophyre, hills east of South Boulder Creek. Nodules from a decomposed mass. Shows sanidine, plagioclase, brown mica, and altered olivine.

	G.	H.	I.
SiO_2	49.13	50.82	50.03
Al_2O_3	9.05	11.44	14.08
Fe_2O_3	3.57	.25	2.92
FeO	5.05	8.94	6.11
MgO	17.21	14.01	10.73
CaO	5.68	8.14	7.46
Na_2O	2.01	1.79	1.46
K_2O	2.24	3.45	2.64
H_2O at 110°	.84	.58	3.70
H_2O above 110°	3.50		
TiO_2	.42	.59	.61
P_2O_5	.38	.20	.42
Cr_2O_3	.39	.03	trace
NiO	trace	trace	trace
MnO	.15	.19	.08
BaO	.05	.06	.04
	99.67	100.49	100.28

J. Hornblende-picrite, North Meadow Creek. Contains hornblende, abundant fresh olivine, grains of pleonaste and iron oxides, and occasionally hypersthene. Sp. gr. 3.35. P. R. C. 973.

K. Pyroxenite, divide between Meadow and Granite creeks. Contains hornblende and hypersthene, with grains of iron oxide. P. R. C. 972.

L. Hypersthene-andesite, northwest of Red Bluff. Contains plagioclase and pyroxene, with an amorphous glassy base, and sometimes olivine altered to chloritic matter.

M. Peridotite, var. wehrlite, hills 3 miles northwest of Red Bluff. Contains olivine, diallage, brown mica, rarely plagioclase, and secondary iron oxides. Sp. gr. 3.37. Analyses J, K, L, and M by Eakins, record No. 1266. P. R. C. 976.

	J.	K.	L.	M.
SiO_2	46.13	51.83	59.48	48.95
Al_2O_3	4.69	7.98	16.37	5.69
Fe_2O_3	.73	1.48	3.21	1.20
FeO	16.87	8.28	3.17	12.11
MgO	25.17	24.10	3.29	23.49
CaO	4.41	5.26	4.88	5.33
Na_2O	.08	.35	3.30	1.58
K_2O	trace	.06	2.81	.79
H_2O	1.38	.29	2.01	.18
TiO_2	.73	.29	.93	.81
P_2O_5	.07	.09	.41	.12
Cr_2O_3	.04	.31	.03	.05
MnO	trace	trace	.19	.08
NiO	.09	.11	trace	.16
BaO	trace	....	.13	trace
S	.24	....	....	....
	100.63	100.43	100.21	100.54
Less O	.12			
	100.51			

The following rocks, at first supposed to be Pliocene sandstones, were also described by Merrill, Amer. Journ. Sci., 3d series, vol. 32, p. 119. All consist of pumiceous volcanic glass. C, from Idaho, is included here for convenience. Analyses by J. E. Whitfield, record No. 382.

A. Little Sage Creek.

B. Devils Pathway.

C. Marsh Creek Valley, Idaho.

Iron and alumina weighed together. The iron is mostly in the ferrous form.

	A.	B.	C.
SiO_2	65.56	65.76	68.92
Al_2O_3, Fe_2O_3	18.24	17.18	16.22
MgO	.72	trace	trace
CaO	2.58	2.30	1.62
Na_2O	2.08	2.22	1.56
K_2O	3.94	3.14	4.00
H_2O at 105°	1.12	3.46	1.60
H_2O at red heat	6.50	5.60	6.00
	100.74	99.66	99.92

The following examples of volcanic dust or sand, from the Gallatin Valley, were collected by A. C. Peale. Analyses A, B, C, and D by F. W. Clarke, record No. 379. Analysis E by H. N. Stokes, record No. 1314.

A. Dry Creek Valley, above the mouth of Pass Creek.

B, C. Near Bozeman.

D. Near Fort Ellis.

E. Essentially rhyolitic glass, described by Iddings in Bull. 150, p. 146. Gallatin Valley.

	A.	B.	C.	D.	E.
SiO_2	46.09	61.82	71.01	60.98	68.68
Al_2O_3	} 14.35	} 19.86	} 15.17	} 21.69	12.69
Fe_2O_3					1.14
FeO	....	....	....	....	1.17
MgO	1.29	.51	.34	1.33	1.14
CaO	1.61	1.78	1.19	1.83	1.11
Na_2O	} 1.47	2.38	2.77	.80	1.23
K_2O		1.31	2.97	1.23	5.58
Ignition	6.45	11.47	6.34	11.96	7.99
MnO	....	....	....	....	trace
$CaCO_3$	28.72	....	....	....	....
	99.98	99.13	99.79	99.82	100.73

2. BUTTE AND BOULDER DISTRICTS.

Rocks received from W. H. Weed and G. W. Tower. The granite rocks are described by Weed in Journ. Geol., vol. 7, p. 737. All the rocks will be described in the 21st Annual Report.

A. Butte granite. A quartz-monzonite, variety banatite, from Walkerville Station. Contains quartz, andesine, orthoclase, hornblende, and biotite, with a little titanite, apatite, and magnetite.

B. Biotite from A.

C. Amphibole from A.

D. Butte granite, like A, from the Frohner mine, 10 miles south of Helena.

Analyses by H. N. Stokes, record Nos. 1686, 1787, 1808.

	A.	B.	C.	D.
SiO_2	63.88	35.79	45.73	64.17
Al_2O_3	15.84	13.70	6.77	15.25
Fe_2O_3	2.11	5.22	4.94	2.16
FeO	2.59	13.72	10.39	2.98
MgO	2.13	12.13	12.32	2.60
CaO	3.97	.05	11.25	4.24
Na_2O	2.81	.15	.77	2.62
K_2O	4.23	9.09	1.22	4.34
H_2O at 110°	.22	1.21	.49	.16
H_2O above 110°	.66	3.64	2.29	.65
TiO_2	.65	3.51	1.43	.67
P_2O_5	.21	.10	.35	.16
MnO	.07	.19	.54	.04
SrO	.02	none	none	trace
BaO	.09	.13	none	.07
Li_2O	trace	trace	trace	trace
SO_3	.34	....	....	.07
Cl	trace	.20	....	trace
F	....	.76	.28	....
	99.82	99.59	98.77	100.18
Less O	....	.37	.12	
		99.22	98.65	

E. Butte granite, Gagnon mine, Butte.

F. Butte granite, Atlantic mine, Butte.

G. Butte granite, Alice mine, Butte. Analyses E, F, and G by W. H. Hillebrand, record No. 1692. Mineralogically the rocks are like A and D.

H. Weathered Butte granite.

I. Altered Butte granite. Decomposed near quartz-pyrite veins. Shows opaline silica, with sericite derived from feldspar. Hornblende gone; mica recognizable only as sericite masses having the form of biotite.

Analyses H and I by Stokes, record Nos. 1792, 1787.

	E.	F.	G.	H.	I.
SiO_2	64.05	64.34	63.87	65.14	64.81
Al_2O_3	15.38	15.72	15.39	15.63	19.44
Fe_2O_3	2.20	1.62	1.93	2.37	1.82
FeO	2.74	2.94	3.08	2.13	.16
MgO	2.08	2.17	2.23	1.85	.19
CaO	4.30	4.24	4.30	3.62	.18
Na_2O	2.74	2.76	2.76	2.63	.21
K_2O	4.00	4.04	4.18	4.29	5.30
H_2O at 110°	.27	.25	.19	.37	1.41
H_2O above 110°	.83	.76	.69	.75	5.25
TiO_2	.60	.53	.65	.59	.73
P_2O_5	.21	.14	.17	.16	.10
ZrO_2	(?)	.02	.03	....	....
MnO	.11	.12	.11	trace	trace
NiO	trace ?	trace ?	trace	....	....
SrO	.04	.03	.04	trace	trace
BaO	.08	.06	.07	.10	.10
CO_2	.35	.03	.15	none	none
SO_2	....	....	....	.05	.31
FeS_2	.07	.03	.07	....	....
Cu	.005	.005	.005	....	....
	100.055	99.805	99.915	99.68	100.01

Traces of lithia in all five rocks of this table.

J. Granite, Boulder type, near Boulder. Near adamellite. Contains quartz, feldspar, black mica, and dark-green hornblende. Has an unusual amount of plagioclase.

K. Bluebird granite, Nettie mine, Butte district. An aplite. Contains orthoclase and quartz, with a little plagioclase and a sprinkling of biotite.

L. Same rock and locality as K. Analysis by W. F. Hillebrand, record No. 1692.

M. Diorite, Red Mountain, east of Butte. Contains pale-green to colorless hornblende, plagioclase varying from labradorite to albite, some orthoclase, and a little quartz. Biotite, apatite, and magnetite also occur.

N. Diorite, Red Mountain. Contact of granite with limestones. Consists mainly of green hornblende and "basic" plagioclase. Little quartz present.

O. Quartz-monzonite, Red Rock Creek, north of Butte. Contains hornblende, augite, biotite, plagioclase, and orthoclase, with a little magnetite and apatite.

Analyses J, K, M, N, and O by H. N. Stokes, record Nos. 1686, 1787.

	J.	K.	L.	M.	N.	O.
SiO_2	67.12	76.87	77.05	56.41	49.22	61.64
Al_2O_3	15.00	12.52	12.84	17.62	12.02	15.63
Fe_2O_3	1.62	.67	.56	1.24	2.77	3.39
FeO	2.23	none	.14	3.55	8.80	2.69
MgO	1.74	.09	trace	3.97	9.29	2.82
CaO	3.43	.49	.57	8.66	10.56	4.90
Na_2O	2.76	2.47	2.81	3.25	1.90	2.64
K_2O	4.52	5.78	5.52	2.61	1.70	3.72
H_2O at 110°	.09	.25	.22	.14	.27	.28
H_2O above 110°	.58	.52	.48	.76	1.63	.91
TiO_2	.48	.11	.12	.68	.95	.71
P_2O_5	.15	.05	none	.49	.43	.21
Cr_2O_3	none					trace
MnO	.06	trace	none	.08	trace	.04
SrO	.03	none	none	.08	.03	.04
BaO	.07	none	none	.09	.03	.08
Li_2O	trace	trace	trace	none	trace	trace
S		trace		none	.05	
SO_3	trace			none	.04	none
Cl		none		.07	.08	
	99.88	99.82	100.31	99.70	99.77	99.70

P. Pitchstone, or rhyolite-dacite obsidian, Butte. Phenocrysts of andesine, quartz, and orthoclase in a glassy base.

Q. Rhyolite, Hyde Park dike, Butte district. Contains sanidine, quartz, plagioclase, and biotite in a groundmass of quartz and feldspar.

R. Rhyolite, top of Red Mountain, Rimini. Quarts and feldspar phenocrysts in a groundmass of the same minerals.

S. Quartz-porphyry, Modoc mine, Butte district. Contains quartz, orthoclase, and plagioclase in a groundmass of quartz and feldspar. A few small biotites are present. Feldspar partly altered to sericite.

T. Andesite-porphyry, Hiawatha Creek, above basin. Contains plagioclase, orthoclase, and augite.

U. Andesite-porphyry, Zosel mining district, near Daylight. Somewhat altered. Contains augite, andesine, and olivine in a groundmass of plagioclase, augite and iron oxide. Ferromagnesian minerals altered to serpentine.

Analysis S by Hillebrand, record No. 1692. P, Q, R, T, and U by Stokes, record Nos. 1686, 1787.

	P.	Q.	R.	S.	T.	U.
SiO_2	67.55	74.34	75.30	69.95	62.53	54.61
Al_2O_3	15.68	12.97	11.95	15.14	19.01	15.23
Fe_2O_3	.98	.75	} 2.17	.38	1.96	3.51
FeO	1.02	.54		.83	1.44	4.80
MgO	1.11	.86	.05	.56	1.29	4.69
CaO	2.51	.85	.62	1.45	5.17	7.41
Na_2O	4.15	2.49	3.09	2.70	3.45	1.46
K_2O	2.86	4.72	4.96	6.36	3.30	2.70
H_2O at 110°	.38	1.03	.36	.40	.21	.32
H_2O above 110°	2.76	1.11	.61	.91	.45	2.47
TiO_2	.34	.18	.17	.24	.65	.86
P_2O_5	.12	.07	trace	.10	.17	.35
ZrO_2	none	.05	....	.02	....	none
MnO	trace	trace	trace	.08	.03	.09
SrO	.03	trace	none	.02	.04	.04
BaO	.11	.07	trace	.13	.13	.11
Li_2O	none	trace	trace	trace	trace	trace
CO_2	none	none	none	.37	none	1.46
SO_3	none	.03	.44	....	none	none
FeS_2	....	....	....	*a* .39	....	....
Cl	.05	none	trace	undet.	....	none
Cu	....	....	....	.03	....	....
Organic matter	....	....	.45	....	....	....
	99.65	100.06	100.17	100.06	99.83	100.11

a Other sulphides than pyrite present.

3. CRAZY MOUNTAINS.

The greater number of the rocks in this group were received from J. E. Wolff, who has supplied the petrographic data. The few exceptions are properly indicated. The three tinguaites and the elæolite-syenite were described by Wolff and Tarr in Bull. Mus. Compar. Zoölogy, vol. 16, No. 12, 1893, in a paper upon "Acmite-Trachyte from the Crazy Mountains." The renaming of these rocks is due to Wolff. The analyses, except when otherwise stated, are by W. F. Hillebrand, record No. 1438.

A. Granitite, Big Timber Creek. Small dikes in main diorite stock. Contains quartz, orthoclase, plagioclase (oligoclase), and biotite.

B. Hornblende-granitite, main stock, Big Timber Creek. Contains biotite, hornblende, quartz, orthoclase, and plagioclase (oligoclase).

C. Granite-porphyry, intrusive sheet, north part of the mountains. Contains orthoclase, albite, quartz, biotite, and green hornblende in a groundmass of quartz and untwinned feldspar.

D. Porphyrite, intrusive sheet, Sweet Grass Creek. Contains hornblende and andesine in a groundmass of plagioclase, orthoclase, and quartz, with accessory magnetite.

E. Porphyrite, dike in contact zone, Sweet Grass Creek. Contains brown hornblende, biotite, and labradorite in a groundmass of plagioclase, biotite, and hornblende, with a little quartz and orthoclase.

F. Porphyrite, intrusive sheet, middle peak of Three Peaks. Contains andesine, hornblende, augite, and biotite in a groundmass of plagioclase, orthoclase, and quartz.

	A.	B.	C.	D.	E.	F.
SiO_2	74.37	64.47	69.93	66.28	64.49	61.08
Al_2O_3	13.12	15.45	14.95	16.21	17.25	16.62
Fe_2O_3	.73	2.25	1.78	.80	.86	2.87
FeO	.87	2.25	.55	2.06	2.42	2.56
MgO	.35	2.68	.60	1.57	1.24	1.65
CaO	1.26	3.63	1.46	3.53	3.79	3.66
Na_2O	2.57	4.54	5.30	4.36	4.19	4.75
K_2O	6.09	3.19	3.99	3.20	4.15	3.90
H_2O at 110°	.05	.05	.12	.12	.06	.44
H_2O above 110°	.25	.63	.32	.78	.54	.97
TiO_2	.29	.75	.33	.50	.51	.73
P_2O_5	.06	.22	.33	.20	.23	.63
MnO	trace	.06	trace	trace	trace	trace
SrO	trace	.04	.06	.05	.08	.08
BaO	.10	.23	.29	.34	.30	.32
Li_2O	trace	trace?	trace	trace?	trace	trace
	100.11	100.44	100.01	100.00	100.11	100.26

G. Porphyrite, intrusive sheet, north of Shields River Basin. Contains plagioclase, hornblende, and biotite, in a groundmass of plagioclase, a little orthoclase, augite, hornblende, and magnetite.

H. Porphyrite, intrusive sheet, northern part of the mountains. Contains brown hornblende, green augite, and plagioclase, in a groundmass of plagioclase, augite, and magnetite, with accessory apatite.

I. Syenite, ridge north of Shields River Basin. Contains hornblende, green augite, and anorthoclase, with accessory sphene, apatite, and magnetite.

J. Diabase-porphyrite (?), dike south of Shields River Basin. Contains labradorite and decomposed augite in a groundmass of plagioclase, epidote, and chlorite.

K. Diorite-porphyrite, Big Timber Creek. Contains labradori augite, hornblende, biotite, orthoclase, quartz, magnetite, and apatite

L. Quartz-diorite, main stock on Sweet Grass Creek. Contains hornblende, biotite, augite, labradorite, orthoclase, and quartz, with accessory apatite, magnetite, olivine, and hypersthene.

	G.	H.	I.	J.	K.	L.
SiO_2	56.75	54.69	58.28	58.28	54.56	53.48
Al_2O_3	16.40	16.53	17.89	19.37	17.58	19.35
Fe_2O_3	4.78	4.54	3.20	1.35	4.30	2.37
FeO	3.10	2.83	1.73	2.98	4.98	4.90
MgO	3.22	2.99	1.51	1.30	2.86	3.67
CaO	5.34	5.34	3.69	4.78	6.00	7.55
Na_2O	4.19	5.19	5.89	4.40	4.43	4.07
K_2O	3.36	3.93	5.34	3.75	2.70	1.41
H_2O at 110°	.40	.32	.17	.44	.02	.16
H_2O above 110°	.82	1.05	.98	1.78	.38	.80
TiO_2	.86	.91	.64	.96	1.34	1.07
P_2O_5	.52	.73	.26	.35	.60	.62
MnO	.17	.07	.06	.07	.06	.06
SrO	.10	.06	.05	.09	.08	.11
BaO	.33	.37	.36	.25	.27	.19
Li_2O	trace?	trace?	trace	trace?	trace	trace?
Cl	....	trace	....	....	....	....
CO_2	....	.83	....	.33	....	.08
	100.34	100.38	100.05	100.48	100.16	99.89

M. Diorite, head of Rock Creek. Contains biotite, labradorite, and augite, in a groundmass of plagioclase, orthoclase, and quartz, with accessory magnetite, apatite, and hornblende.

N. Diorite, main stock, Big Timber Creek. Contains biotite, augite, labradorite, quartz, orthoclase, apatite, and magnetite.

O. Olivine-gabbro, Big Timber Creek. Contains labradorite (?), brown hornblende, augite, olivine, and magnetite.

P. Rock from Musselshell River, north of Crazy Mountains. Received from J. S. Diller, but undescribed. Regarded by W. H. Weed as monchiquite. Analysis by L. G. Eakins, record No. 1021.

Q. Hornstone, metamorphosed shale, contact zone, Sweet Grass Creek. An aggregate of augite, quartz, triclinic feldspar, and biotite.

	M.	N.	O.	P.	Q.
SiO_2	57.97	50.73	40.42	44.66	57.31
Al_2O_3	15.65	19.99	9.98	12.12	14.24
Fe_2O_3	.73	3.20	9.83	5.81	1.00
FeO	2.80	4.66	10.67	3.20	3.24
MgO	4.96	3.48	11.56	8.77	4.60
CaO	10.93	8.55	10.78	8.14	11.31
Na_2O	3.03	4.03	1.26	4.47	2.64
K_2O	3.16	1.89	.60	2.75	4.55
H_2O at 110°	.22	.11	.45	4.33	.25
H_2O above 110°	.38	.66	1.17		.24
TiO_2	.60	1.59	2.51	1.02	.52
P_2O_5	.15	.81	.63	2.02	.18
(CoNi) O			.02		
MnO	trace	.05	.25	.21	.08
SrO	.02	.11	.02		trace?
BaO	.09	.27	.05		.19
Li_2O	trace	trace	trace		trace?
CO_2				2.19	.17
Cl	trace				
F	trace				
	100.69	100.13	100.20	99.69	100.52

R. Elæolite-syenite, Peaked Butte, northeast side of the mountains. Described by Wolff and Tarr, *l. c.* Contains anorthoclase, augite, occasionally sodalite, ægirine, apatite, magnetite, and some interstitial nephelite. Analysis by W. H. Melville, record No. 1291.

Ra. Anorthoclase from R. Analysis by W. F. Hillebrand, record No. 1297.

S. Tinguaite, var. sölvsbergite, intrusive sheet north of Shields River.

T. Tinguaite, var. sölvsbergite, dike north part of mountains.

U. Tinguaite, var. sölvsbergite, dike at head of Sixteenmile Creek.

S, T, and U are the rocks described by Wolff and Tarr in their paper upon "Acmite-Trachyte." Mineral composition the same as under R. Analyses by W. H. Melville, record No. 1291.

	R.	Ra.	S.	T.	U.
SiO_2	59.66	62.31	58.70	62.17	64.33
Al_2O_3	16.97	22.63	19.26	18.58	17.52
Fe_2O_3	3.18	....	3.37	2.15	3.06
FeO	1.15	....	.58	1.05	.94
MgO	.80	....	.76	.73	.34
CaO	2.32	.63	1.41	1.57	.56
Na_2O	8.38	7.68	8.55	7.56	7.30
K_2O	4.17	4.79	4.53	3.88	4.28
H_2O at 105°	.07	.16	.07	.07	.04
H_2O above 105°	2.53	.72	2.57	1.63	.95
TiO_2	trace	....	trace	trace	trace
P_2O_5	.14	....	.10	.11	trace
MnO	.19	....	.10	trace	.35
SrO	....	.57	....	....	....
BaO	....	.77	....	....	....
	99.56	100.26	100.00	99.50	99.67

V. Theralite, Gordons Butte. Contains green augite, ægirine, biotite, olivine, nephelite, sodalite, and a feldspar, partly sanidine, containing K, Na, Ba, Sr, and Ca; also accessory apatite, magnetite, and sphene.

W. Theralite, Gordons Butte; another sample. Analysis by E. A. Schneider, record No. 1281.

X. Theralite, north of Alabaugh Creek. Descrided by Wolff for the Educational Series. Contains augite, ægirine, biotite, olivine, magnetite, apatite, nephelite partly zeolitized, a mineral of the sodalite group, sanidine, and analcite. Analysis by Schneider, No. 1281.

Rocks V, W, and X are described by Wolff in Bull. 150, pp. 197, 199.

Y. Altered theralite, head of Shields River, west of Loco Mountain. Received from W. H. Weed. Analysis by H. N. Stokes, record No. 1547.

Z. Hornblende-picrite, Conical Peak. Data supplied by J. P. Iddings. Contains hornblende, plagioclase, hypersthene, augite, olivine, very little primary quartz, and probably some magnetite and apatite. Analysis by L. G. Eakins, record No. 1379.

	V.	W.	X.	Y.	Z.
SiO_2	44.65	44.31	47.67	48.90	45.71
Al_2O_3	13.87	17.20	18.22	14.70	10.80
Fe_2O_3	6.06	4.64	3.65	4.14	4.43
FeO	2.94	3.73	3.85	3.68	9.35
MgO	5.15	6.57	6.35	3.95	13.75
CaO	9.57	10.40	8.03	8.26	10.48
Na_2O	5.67	4.45	4.93	5.22	1.58
K_2O	4.49	3.64	3.82	.56	.85
H_2O at 110°	.96	.77	.38	.52	.97
H_2O above 110°	2.10	3.30	2.97	2.44	
TiO_2	.95	undet.	undet.	.95	1.83
P_2O_5	1.50	....	....	.79	.11
Cr_2O_3	....	....	....	....	.10
MnO	.17	.10	.28	.03	.17
SrO	.37	....	....	.13	....
BaO	.76	....	....	.31	trace
Li_2O	trace	....	....	trace	....
CO_2	.11	....	....	5.42	....
SO_3	.61	....	....	.04	....
Cl	trace	....	....	....	....
	99.92	99.11	100.15	100.04	100.13

4. LITTLE BELT MOUNTAINS.

Rocks collected by W. H. Weed and L. V. Pirsson, who furnish the petrographic data. To be described in a paper on the Neihart and Barker mining districts in Pt. III of the 20th Ann. Analyses by W. F. Hillebrand, record No. 1476, and H. N. Stokes, record No. 1547.

A. Quartz-porphyry, Yogo Peak, sheet at head of Belt and Running Wolf creeks. Phenocrysts of orthoclase and quartz in a groundmass of quartz and alkali feldspar, with a little white mica and some kaolin. Chlorite, limonite, and calcite are also present, pseudomorphous after biotite and perhaps hornblende. Total amount of secondary minerals very small. Analysis by Hillebrand.

B. Granite-porphyry, Wolf Butte. Phenocrysts of quartz, orthoclase, plagioclase, and biotite in a groundmass of quartz and alkali feldspar. A little apatite and iron ore, with secondary calcite, limonite, chlorite, and white mica. Analysis by Stokes.

C. Granite-porphyry, top of Barker Mountain. Phenocrysts of orthoclase, oligoclase, biotite, green hornblende, sphene, and iron ore, in a groundmass of quartz and alkali feldspar. Also a little apatite and some secondary chlorite and limonite. Analysis by Stokes.

D. Syenite, Wright and Edwards mine, Hughesville, near Barker. Very fresh rock. Contains magnetite, ilmenite, hornblende, anorthoclase, albite, subordinate quartz, a little chlorite, calcite, and limonite, and white mica in traces. Analysis by Stokes.

E. Syenite, Yogo Peak. Described in Amer. Journ. Sci., 3d series, vol. 50, p. 471. Contains apatite, sphene, iron ore, pyroxene, hornblende, biotite, orthoclase, oligoclase, and quartz, with traces of chlorite and limonite and a little kaolin. Analysis by Hillebrand.

F. Syenite-porphyry, dike at head of Sheep Creek. Phenocrysts of orthoclase, some plagioclase, and green hornblende, in a groundmass of alkali feldspar, with some quartz. Also contains a little apatite and iron ore, with some secondary calcite and kaolin. Analysis by Hillebrand.

	A.	B.	C.	D.	E.	F.
SiO_2	73.12	69.68	68.60	64.64	61.65	66.29
Al_2O_3	14.27	14.97	16.13	16.27	15.07	15.09
Fe_2O_3	.51	.79	2.22	2.42	2.03	1.37
FeO	.26	.34	.44	1.58	2.25	1.17
MgO	.24	.66	.72	1.27	3.67	2.39
CaO	1.10	2.10	1.36	2.65	4.61	2.38
Na_2O	3.43	3.38	4.37	4.39	4.35	3.96
K_2O	4.90	4.40	4.89	4.98	4.50	4.91
H_2O at 110°	.68	1.09	.20	.09	.26	.39
H_2O above 110°	.73	.92	.58	.27	.41	.60
TiO_2	.08	.28	.32	.51	.56	.27
P_2O_5	.03	.17	.18	.37	.33	.15
Cr_2O_3	none	....	....	....	trace	none
MnO	.06	trace	trace	trace	.09	.06
SrO	trace	.06	.09	.08	.10	.07
BaO	trace	.14	.27	.18	.27	.30
Li_2O	trace	trace	trace	....	trace	trace
CO_2	.77	.88	....	.37	....	.45
SO_3	....	trace	trace	trace	....	....
Cl	....	trace	trace	.05	....	....
	100.18	99.86	100.37	100.12	100.15	99.85

G. Syenite-porphyry, intrusive sheet, between Yogo Peak and Big Baldy Mountain. Abundant phenocrysts of hornblende and orthoclase, with less biotite and plagioclase, in a groundmass of alkali feldspar with accessory quartz. Also contains iron ore and apatite, with secondary calcite, chlorite, sericite, and kaolin. Analysis by Hillebrand.

H. Granite-syenite-porphyry, north end of Thunder Mountain. Phenocrysts of orthoclase, oligoclase, hornblende, and biotite, in a groundmass of alkali feldspar and very abundant quartz. Also contains a little sphene, iron ore, and apatite, very little secondary chlorite and limonite, and a trace of kaolin. Analysis by Stokes.

I. Quartz-syenite-porphyry, top of Big Baldy Mountain. Phenocrysts of orthoclase, plagioclase, biotite, iron ore, brown hornblende, and sphene, in a groundmass of quartz and alkali feldspar. Also contains a little apatite, with traces of chlorite, limonite, and kaolin. Analysis by Hillebrand.

J. Syenite-diorite-porphyry, talus slope on west side of Bear Park. Phenocrysts of biotite, hornblende, plagioclase, and orthoclase, in a groundmass of quartz and alkali feldspar. Also contains a little magnetite, chlorite, white mica, and apatite. Analysis by Stokes.

K. Diorite-porphyry, Steamboat Mountain. Phenocrysts of orthoclase, plagioclase, hornblende, and biotite, with a little iron ore and apatite, in a groundmass of orthoclase, plagioclase, and quartz. Analysis by Stokes.

L. Diorite, Carpenter Creek, near Neihart. Contains green hornblende, biotite, and plagioclase, with some apatite, iron ore, calcite, kaolin, and muscovite, and a very little quartz and orthoclase. Analysis by Hillebrand.

	G.	H.	I.	J.	K.	L.
SiO_2	62.58	67.44	67.04	64.95	62.18	55.13
Al_2O_3	16.42	15.78	15.25	15.44	15.77	20.27
Fe_2O_3	2.46	1.58	1.69	2.02	1.83	1.52
FeO	1.96	.85	1.13	1.60	2.44	4.29
MgO	1.84	1.43	1.75	2.65	3.55	1.80
CaO	2.47	2.38	2.17	3.07	4.13	7.05
Na_2O	4.57	4.11	4.09	4.25	3.92	4.31
K_2O	3.91	4.87	5.10	3.87	3.91	2.84
H_2O at 110°	.38	.32	.56	.26	.30	.14
H_2O above 110°	1.40	.70	.51	.85	.70	.95
TiO_2	.40	.32	.20	.39	.55	.74
P_2O_5	.33	.21	.21	.25	.32	.40
MnO	.08	trace	.05	trace	trace	.13
SrO	.10	.09	.03	.10	.16	.06
BaO	.41	.24	.33	.35	.43	.11
Li_2O	trace	trace	trace?	....	trace	trace
CO_2	.77	....	....	....	....	.26
SO_3	....	trace	....	.02	trace	....
Cl	....	trace	....	.04	.04	....
	100.08	100.32	100.11	100.11	100.23	100.00

M. Minette, intrusive sheet, head of Sheep Creek. Chiefly biotite augite, and orthoclase, with accessory apatite, plagioclase, quartz, and iron ore, and some secondary calcite, chlorite, and kaolin. Analysis by Hillebrand.

N. Monzonite, Yogo Peak. Described in Amer. Journ. Sci., 3d series, vol. 50, p. 473, and 4th series, vol. 1, p. 356. Contains apatite, sphene, iron ore, pyroxene, hornblende, biotite, orthoclase, and oligoclase, and a little secondary kaolin. Analysis by Hillebrand.

O. Monchiquite, dike on Big Baldy Mountain. Contains much pyroxene, a few serpentinized olivines, iron ore, and apatite in a colorless base of analcite. Analysis by Hillebrand.

P. Monchiquite, dike on Bandbox Mountain. Contains olivine, augite, biotite, analcite, and apatite, with traces of serpentine and chlorite. Analysis by Stokes.

Q. Shonkinite, Yogo Peak. Described in Amer. Journ. Sci., 3d series, vol. 50, p. 474. Chiefly augite and orthoclase, with a considerable amount of accessory biotite, iron ore, and andesine, less apatite and olivine, and a trace of kaolin. Analysis by Hillebrand.

	M.	N.	O.	P.	Q.
SiO_2	52.26	54.42	48.35	48.39	48.98
Al_2O_3	13.96	14.28	13.27	11.64	12.29
Fe_2O_3	2.76	3.32	4.38	4.09	2.88
FeO	4.45	4.13	3.23	3.57	5.77
MgO	8.21	6.12	8.36	12.55	9.19
CaO	7.06	7.72	9.94	7.64	9.65
Na_2O	2.80	3.44	3.35	4.14	2.22
K_2O	3.87	4.22	3.01	3.24	4.96
H_2O at 110°	1.53	.22	.90	.28	.26
H_2O above 110°	1.34	.38	2.89	2.56	.56
TiO_2	.58	.80	.52	.73	1.44
P_2O_5	.52	.59	.40	.45	.98
Cr_2O_3	trace	trace	trace	.07	trace
NiO	....	....	.04	....	....
MnO	.14	.10	.19	trace	.08
SrO	.05	.13	.09	.15	.08
BaO	.23	.32	.54	.32	.43
Li_2O	trace	trace	trace	trace	trace
SO_3	....	....	....	.08	....
Cl	....	....	....	trace	....
CO_2	.49	....	.30	....	....
F	....	....	.25	....	.22
	100.25	100.19	100.01	99.90	99.99

5. CASTLE MOUNTAIN DISTRICT.

Rocks described by Weed and Pirsson in Bull. 139. Analyses made by Pirsson in the laboratory of the Sheffield Scientific School.

A. Rhyolite, between Fourmile and Fivemile creeks, near Smith River. Contains quartz, soda orthoclase, tourmaline, and a little iron ore and zircon. P. R. C. 560.

B. Quartz-tourmaline-porphyry, upper Fourmile Creek. Contains quartz, orthoclase, plagioclase, tourmaline, fluorite, and a little white mica, apatite, and zircon. P. R. C. 558.

C. Granite, Elk Peak. Contains quartz, orthoclase, oligoclase, biotite, hornblende, iron ore, apatite, sphene, and zircon. The last three minerals are rare. P. R. C. 551.

D. Quartz-porphyry, sheet on ridge between Fourmile and Checkerboard creeks. Contains quartz, plagioclase, an untwinned feldspar and biotite, with occasional grains of iron ore and crystals of apatite and zircon. P. R. C. 557.

E. Rhyolite-pitchstone, forks of Checkerboard Creek. Essentially glass, inclosing grains of iron ore. P. R. C. 561.

F. Aplitic granite, dike between Blackhawk and Robinson. Contains quartz and unstriated feldspar, some plagioclase, and occasional biotite. P. R. C. 553.

G. Quartz-porphyry, Musselshell Canyon. Contains quartz, biotite, plagioclase, apatite, iron ore, and zircon. P. R. C. 556.

	A.	B.	C.	D.	E.	F.	G.
SiO_2	74.90	74.82	72.48	72.38	72.56	72.88	71.67
Al_2O_3	13.64	13.80	13.14	14.71	12.33	12.90	15.82
Fe_2O_3	.66	.37	1.66	1.09	.80	.74	1.18
FeO	.50	.30	1.02	.82	.82	1.05	.35
MgO	trace	.10	.15	.70	trace	.75	.13
CaO	.61	.17	1.04	.67	trace	.81	.25
Na_2O	4.22	4.33	4.22	4.28	5.36	3.72	4.46
K_2O	4.64	4.81	4.88	4.15	3.08	5.03	4.45
H_2O	.33	.83	.42	.92	4.59	1.22	1.21
TiO_2	.15	.25	.32	.10	.20	.45	.10
MnO	trace	trace	trace	trace	trace	.05	trace
Li_2O	trace	trace	trace	trace	....	....	....
	99.65	99.78	99.33	99.82	99.74	99.60	99.62
Sp. gr	2.61	2.59	2.62	2.61	2.37	2.64	2.60

H. Feldspar-porphyry, dike below Castle. Contains orthoclase, less plagioclase, hornblende, biotite partly altered to chlorite, sometimes allanite, and occasional iron ore, apatite, and zircon. P. R. C. 555.

I. Rhyolitic tuff, near forks of Checkerboard Creek. Contains fragments of shale, quartz, plagioclase, sanidine, and hornblende, in a brownish material carrying pumiceous glass. Much decomposed, with formation of kaolin. P. R. C. 562.

J. Syenitic mass included in granite, head of Cottonwood Creek. Contains orthoclase, plagioclase, quartz, hornblende, biotite, apatite, and iron ore. A hornblende-mica-syenite. P. R. C. 554.

K. Diorite, between Blackhawk and Robinson. Contains plagioclase, orthoclase, quartz, biotite, diallage, hypersthene, iron ore, apatite, and zircon. P. R. C. 559.

L. Basalt, Volcano Butte. Contains labradorite, augite, olivine, a little serpentine, occasional quartz grains, small patches of glass, iron ore, chiefly ilmenite, apatite, a trace of calcite, and a mineral which may be nephelite or analcite. P. R. C. 565.

M. Augite-vogesite, dike on west side of upper Fourmile Creek. Contains augite, hornblende, iron ore, a little plagioclase, orthoclase, calcite, and some decomposition products. P. R. C. 563.

N. Monchiquite-like dike rock, west side of upper Willow Creek. Contains augite, olivine, biotite, ilmenite, and a colorless base which appears to be partially zeolitized glass. Also a little serpentine, chlorite, and calcite. P. R. C. 564.

	H.	I.	J.	K.	L.	M.	N.
SiO_2	65.87	61.21	61.87	56.80	46.52	45.15	42.46
Al_2O_3	16.82	15.67	17.26	18.30	10.48	15.39	12.04
Fe_2O_3	1.58	4.06	2.35	1.64	4.40	2.76	3.19
FeO	1.23	.62	2.43	5.58	7.79	5.64	5.34
MgO	1.54	1.58	1.82	3.63	10.58	6.38	12.40
CaO	2.65	2.18	3.23	5.31	9.49	8.83	12.14
Na_2O	4.72	1.57	5.18	4.35	3.12	2.67	1.21
K_2O	3.15	2.75	3.83	3.28	1.55	2.77	2.68
H_2O	1.43	10.20	1.07	.53	1.79	2.85	4.03
TiO_2	.37	.56	.87	.46	2.98	2.80	2.47
P_2O_5	trace	....	trace	trace	.83	.56	.84
X[a]	....	....	....	....	.73	....	....
MnO	trace	.10	.03	trace	.11	.14	.16
Li_2O	....	trace	trace	trace	trace	trace	trace
CO_2	....	....	....	....	trace	4.27	.55
	99.36	100.50	99.94	99.88	100.37	100.21	99.51
Sp. gr	2.62	....	2.67	2.83	2.99	2.70	2.94

[a] Unseparated rare earths or metallic acids, such as columbic, tantalic, etc.

6. HIGHWOOD MOUNTAINS.

Rocks collected by W. H. Weed and L. V. Pirsson, who furnish the petrographic data. Analyses made in the laboratory of the Sheffield Scientific School, under the direction of Professor Pirsson.

A. Trachy-andesitic breccia, head of north fork of Willow Creek. Contains hornblende, biotite, iron ore, apatite, plagioclase, and orthoclase, with a little kaolin and limonite. E. B. Hurlbut and B. Barnes, analysts.

B. Trachyte, dike 1 mile north of divide in Highwood Gap. Contains abundant phenocrysts of orthoclase and augite in a groundmass of the same minerals; also a little biotite, apatite, and iron ore, and some secondary kaolin. E. B. Hurlbut, analyst.

C. Trachyte, dike north end of South Mountain. Contains phenocrysts of alkali feldspar, ægirine-augite, and melanite, in a groundmass of alkali feldspar. Apatite, iron ore, a trace of calcite, and some kaolin are also present. H. W. Foote, analyst.

D. Trachyte, dike on Aspen Creek. Contains alkali-hornblende and alkali-feldspar phenocrysts, in a groundmass of alkali feldspars; also some apatite and iron ore. Rock stained by limonite. H. W. Foote, analyst.

E. Trachyte, dike at head of Shonkin Creek. Contains augite, biotite, iron ore, and orthoclase, in a groundmass of alkali feldspar; also apatite and some kaolin. W. M. Bradley, analyst.

	A.	B.	C.	D.	E.
SiO_2	59.24	58.04	57.18	55.23	51.94
Al_2O_3	13.84	17.24	18.54	18.31	15.78
Fe_2O_3	5.46	2.49	3.65	4.90	4.07
FeO	1.36	1.24	1.15	2.06	3.17
MgO	4.79	1.79	.69	1.85	3.48
CaO	5.60	3.50	2.31	3.62	6.04
Na_2O	3.13	3.37	4.48	4.02	3.44
K_2O	4.22	10.06	8.58	6.43	7.69
H_2O	2.02	1.95	2.10	1.84	2.17
TiO_2	.22	.30	.30	.42	.39
P_2O_5	.34	.22	.05	.58	.59
MnO	trace	trace	trace	trace	trace
SrO	none	undet	trace	trace	.28
BaO	trace	undet	.49	.46	.42
SO_3	.08	trace	.06	.23	.29
CO_2	none	....	....	none	....
Cl	.04	.38	.77	.32	.08
	100.34	100.58	100.35	100.27	99.83
Less O	.01	.09	.17	.08	.02
	100.33	100.49	100.18	100.19	99.81

F. Syenite, top of Palisade Butte. Contains augite, iron ore, apatite, alkali feldspar, a little biotite, some limonite in cracks, much natrolite, and possibly other zeolites. H. W. Foote, analyst.

G. Leucite-syenite, head of Davis Creek. Contains augite, iron ore, olivine, biotite, apatite, alkali feldspar, leucite, and some zeolites, with traces of limonite and serpentine. E. B. Hurlbut, analyst.

H. Monchiquite, dike east side of Highwood Gap. Contains augite, olivine, biotite, iron ore, apatite, and analcite, with some serpentine and a little kaolin. H. W. Foote, analyst.

I. Leucite-basalt, saddle between Highwood and Pinewood peaks. Contains augite, iron ore, leucite, apatite, altered olivine, chlorite, calcite, and zeolites. H. W. Foote, analyst.

J. Leucite-basalt or leucite-monchiquite, dike on Arrow Peak. Phenocrysts of augite, olivine, and biotite, with some leucite, in a groundmass of the same minerals. Also analcite, iron ore, and apatite. H. W. Foote, analyst.

	F.	G.	H.	I.	J.
SiO_2	50.11	49.59	47.82	47.98	46.04
Al_2O_3	17.13	14.51	13.56	13.34	12.23
Fe_2O_3	3.73	3.51	4.73	4.09	3.86
FeO	3.28	5.53	4.54	4.24	4.60
MgO	2.47	6.17	7.49	7.01	10.38
CaO	5.09	9.04	8.91	9.32	8.97
Na_2O	3.72	3.52	4.37	3.51	2.42
K_2O	7.47	5.60	3.23	5.00	5.77
H_2O	4.47	1.95	3.37	2.10	2.87
TiO_2	.82	.36	.67	.58	.64
P_2O_5	.67	.15	1.10	1.03	1.14
MnO	trace	trace	trace	trace	trace
SrO	.35	.21	.21	.14	.25
BaO	.63	.49	.16	.50	.48
SO_3	.08	.02	trace	trace	trace
CO_2	....	....	....	1.24	....
Cl	.07	.13	.04	.21	.11
	100.09	100.78	100.20	100.29	99.76
Less O	.02	.03	.01	.07	.03
	100.07	100.75	100.19	100.22	99.73

K. Missourite, head of Shonkin Creek. Described in Amer. Journ. Sci., 4th series, vol. 2, p. 315. Contains apatite, iron ore, olivine, biotite, augite, and leucite, the two latter being the chief minerals. Some zeolites and analcite are also present. E. B. Hurlbut, analyst.

L. Pseudo leucite-syenite, head of Shonkin Creek. Contains augite, olivine, biotite, iron ore, apatite, orthoclase, nephelite, zeolites, and traces of serpentine, limonite, and kaolin. Contains pseudomorphs after leucite. E. B. Hurlbut, analyst.

M. Monzonite, Highwood Peak. Contains augite, biotite, iron ore, apatite, plagioclase, and alkali feldspar. E. B. Hurlbut, analyst.

N. Monzonite, Middle Peak. Contains augite, olivine, biotite, iron ore, apatite, plagioclase, and orthoclase. The two latter, with augite, are the chief minerals. E. B. Hurlbut, analyst.

	K.	L.	M.	N.
SiO_2	46.06	51.75	51.00	52.05
Al_2O_3	10.01	14.52	17.21	15.02
Fe_2O_3	3.17	5.08	2.41	2.65
FeO	5.61	3.58	4.23	5.52
MgO	14.74	4.55	6.19	5.39
CaO	10.55	7.04	9.15	8.14
Na_2O	1.31	2.93	2.88	3.17
K_2O	5.14	7.61	4.93	6.10
H_2O	1.44	2.25	.63	.35
TiO_2	.73	.23	.13	.47
P_2O_5	.21	.18	.33	.21
MnO	trace	trace	trace	trace
SrO	.20	.07	.14	.28
BaO	.32	.30	.34	.42
SO_3	.05	trace	.03	.02
Cl	.03	.05	trace	.24
	99.57	100.14	99.60	100.03
Less O	.01	.01	....	.06
	99.56	100.13	....	99.97

The following rock and separations, from Square Butte, at the east end of the Highwood Mountains, are described by Lindgren in Amer. Journ. Sci., 3d series, vol. 45, p. 286. Analyses by W. H. Melville, record No. 1268.

A. Post-Cretaceous sodalite-syenite. Contains orthoclase, some albite, hornblende, sodalite, analcite, and apatite. Orthoclase predominates. The sodalite amounts to 8 per cent. P. R. C. 184.

B. Hornblende separated from A. Near barkevikite.

C. Sodalite from A. Sp. gr. 2.265.

D. Analcite from A. Sp. gr. 2.255.

In addition, the orthoclase gave 3.88 per cent Na_2O and 11.03 per cent K_2O. A separation of mixed feldspars, sp. gr. 2.56, gave 6.08 per cent Na_2O and 8.91 per cent K_2O.

	A.	B.	C.	D.
SiO_2	56.45	38.41	41.56	49.54
Al_2O_3	20.08	17.65	29.48	25.07
Fe_2O_3	1.31	3.75	----------	----------
FeO	4.39	21.75	.49	.40
MgO	.63	2.54	.15	.20
CaO	2.14	10.52	.49	.22
Na_2O	5.61	2.95	19.21	15.32
K_2O	7.13	1.95	.91	.89
H_2O at 100°	.26	----------	.45	undet.
H_2O above 100°	1.51	.24	3.73	undet.
TiO_2	.29	----------	----------	----------
P_2O_5	.13	----------	----------	----------
NiO	trace	trace	----------	----------
MnO	.09	.15	----------	----------
Cl	.43	----------	4.79	1.67
	100.45	99.91	101.26	93.31
Less O	.10	----------	1.08	.38
	100.35	----------	100.18	92.93

7. LITTLE ROCKY MOUNTAINS.

Granite-syenite-porphyry. Described by Weed and Pirsson, Journal of Geology, vol. 4, p. 399. Contains orthoclase, quartz, oligoclase, iron oxides, and a little muscovite. Analysis by H. N. Stokes, record No. 1558. P. R. C. 905.

SiO_2	68.65	P_2O_5	trace
Al_2O_3	18.31	MnO	trace
Fe_2O_3	.56	SrO	.10
FeO	.08	BaO	.13
MgO	.12	Li_2O	trace
CaO	1.00	SO_3	trace
Na_2O	4.86	Cl	.03
K_2O	4.74	F	trace
H_2O at 110°	.27		99.88
H_2O above 110°	.83		
TiO_2	.20		

8. BEARPAW MOUNTAINS.

Described by Weed and Pirsson, Amer. Journ. Sci., 4th series, vol. 1, pp. 283 and 351, and vol. 2, pp. 136 and 188. Analyses by H. N. Stokes, record Nos. 1558 and 1572.

A. Quartz-syenite-porphyry, Gray Butte. Contains anorthoclase, microlites of plagioclase, ægirite, augite, quartz, and apatite, with an occasional zircon and very few biotite leaves. P. R. C., 897.

B. Quartz-syenite, Beaver Creek stock. Contains orthoclase, albite, quartz, augite, and iron oxides, with very little biotite, hornblende, and sphene. P. R. C., 900.

C. Basic syenite or monzonite (yogoite), Beaver Creek. Contains orthoclase, plagioclase, diopside, biotite, iron oxides, and apatite. P. R. C., 902.

	A.	B.	C.
SiO_2	66.22	68.34	52.81
Al_2O_3	16.22	15.32	15.66
Fe_2O_3	1.98	1.90	3.06
FeO	.16	.84	4.76
MgO	.77	.54	4.99
CaO	1.32	.92	7.57
Na_2O	6.49	5.45	3.60
K_2O	5.76	5.62	4.84
H_2O at 110°	.08	.15	.16
H_2O above 110°	.24	.30	.93
TiO_2	.22	.21	.71
P_2O_5	.10	.13	.75
MnO	trace	.07	trace
SrO	.06	.04	.09
BaO	.29	.08	.24
Li_2O	trace	none	trace
SO_3	.02	trace	trace
Cl	.04	.04	.07
F	trace	none?	trace
	99.97	99.95	100.24

D. Shonkinite, Beaver Creek. Contains anorthoclase, diopside, biotite, iron oxides, and apatite, with very little olivine and probably a trace of nephelite. P. R. C. 901.

E. Leucitite, Bearpaw Mountains. An olivine-free leucite-basalt. Contains leucite, augite, iron oxides, rarely biotite, and very little glassy base. P. R. C. 903.

F. Tinguaite, dike on Bear Creek. Contains orthoclase, nephelite, cancrinite, augite, ægirite, apatite, a little sodalite, and a doubtful fibrous hornblende. P. R. C. 899.

G. Pseudo leucite-sodalite-tinguaite, Beaver Creek. Contains orthoclase, nephelite, sodalite, nosean, ægirite, diopside, and fluorite. P. R. C. 904.

	D.	E.	F.	G.
SiO_2	50.00	46.51	57.46	51.93
Al_2O_3	9.87	11.86	15.40	20.29
Fe_2O_3	3.46	7.59	4.87	3.59
FeO	5.01	4.39	.87	1.20
MgO	11.92	4.73	1.37	.22
CaO	8.31	7.41	2.59	1.65
Na_2O	2.41	2.39	5.48	8.49
K_2O	5.02	8.71	9.44	9.81
H_2O at 110°	.17	1.10	.09	.10
H_2O above 110°	1.16	2.45	.82	.99
TiO_2	.73	.83	.60	.20
P_2O_5	.81	.80	.21	.06
Cr_2O_3	.11	none	----	----
NiO	.07	.04	----	----
CoO	----	trace	----	----
MnO	trace	.22	trace	trace
CuO	----	trace	----	----
SrO	.07	.16	.16	.07
BaO	.32	.50	.60	.09
Li_2O	trace	trace	trace	trace
SO_3	.02	.05	.13	.67
CO_2	.31	none	.13	.25
Cl	.08	.04	.20	.70
F	.16	trace	trace	.27
	100.01	99.78	100.42	100.58
Less O	.08	.02	.05	.27
	99.93	99.76	100.37	100.31

IDAHO.

Rocks collected by Waldemar Lindgren, who furnishes the petrographic data. Those from Silver City and Hailey will be described in 20th Ann., Part III.

A. Quartz-monzonite, Idaho-Democrat mine, Hailey. Contains quartz, orthoclase, microcline, oligoclase, biotite, apatite, titanite, and magnetite. Sp. gr. 2.672, 27.5°.

B. Same rock and locality as A, but in altered condition. Contains quartz, sericite, chlorite, calcite, pyrite, rutile, etc. Sp. gr. 2.472, 29°.

C. Gabbro, related to diorite, Crœsus mine, Hailey. Contains labradorite, biotite, diallage, hypersthene, hornblende, quartz, titanite, magnetite, orthoclase, and chlorite. Sp. gr. 2.826, 28°.

D. Same rock and locality as C, but in altered condition. Contains quartz, sericite, chlorite, calcite, pyrite, arsenopyrite, rutile, etc. Sp. gr. 2.898, 28°.

Analyses A to D by W. F. Hillebrand, record No. 1826. The metals which are bracketed with sulphur represent sulphides. Traces of lithia are present in all four.

	A.	B.	C.	D.
SiO_2	68.42	71.93	57.78	58.01
Al_2O_3	15.01	12.21	16.28	15.72
Fe_2O_3	.97	.64	1.02	.64
FeO	1.93	2.99	4.92	3.87
MgO	1.21	.58	4.60	2.07
CaO	2.60	2.59	6.65	2.15
Na_2O	3.23	.23	3.25	.10
K_2O	4.25	3.29	2.22	4.79
H_2O at 105°	.54	.37	.34	.31
H_2O above 105°	.73	2.06	.92	2.71
TiO_2	.50	.40	1.07	1.08
P_2O_5	.13	.10	.30	.31
CoO, NiO	none	none	.02	none
MnO	.06	.18	.15	.17
SrO	.03	none	.07	none
BaO	.12	trace	.12	trace ?
CO_2	.20	1.95	.15	2.86
S	.02	.18	.02	1.25
Fe	....	.13	....	1.52
Co, Ni	....	none	....	.12
Zn	....	.09	....	....
Pb	....	trace	....	.86
Cu	....	none	....	.05
As	....	....	....	1.65
	99.95	99.92	99.88	100.24

E. Altered rhyolite, De Lamar mine, Silver City, contains quartz, sericite, pyrite, apatite, and rutile, with some undeterminable magnesian mineral. Analysis by H. N. Stokes, record No. 1731.

F. Altered rhyolite, De Lamar mine. Contains sericite, quartz, kaolinite, and pyrite. Sp. gr., 2.655, 23°.

G. Altered rhyolite, De Lamar mine. Contains quartz, sericite, kaolinite, and pyrite. Sp. gr., 2.576, 24°.

H. Diabasic basalt, Trade Dollar mine, Silver City. Contains labradorite, augite, chlorite, magnetite, secondary quartz, etc.

Analyses F, G, and H by Hillebrand, record No. 1826.

	E.	F.	G.	H.
SiO_2	66.69	87.37	78.59	48.47
Al_2O_3	15.40	7.44	12.13	16.07
Fe_2O_3	1.84	.09	none	4.12
FeO	undet	.18	.09	7.47
MgO	.85	.12	.41	5.96
CaO	.09	.10	.16	4.84
Na_2O	.16	.14	.10	2.43
K_2O	3.50	1.79	2.55	1.41
H_2O at 105°	.83	.51	.82	2.30
H_2O above 105°	2.97	1.39	2.47	4.63
TiO_2	2.11	.09	.12	1.51
P_2O_5	.08	trace	trace	.44
CoO, NiO	....	none	none	trace
MnO	trace	trace?	trace?	.23
SrO	....	none	none	trace
BaO	.09	.02	.02	.03
Li_2O	....	trace	trace	trace
SO_3	.11	....	....	....
FeS_2	3.99	1.00	2.61	.24
Cu	....	....	....	trace
	98.71	100.24	100.07	100.15

Heavy metals not looked for in E.

I. Quartz-monzonite, Schafer Butte, Boise County. Contains quartz, orthoclase, oligoclase, biotite, apatite, titanite, and magnetite. To be described in 20th Ann. Analysis by George Steiger, record No. 1802.

J. Granodiorite, Silver Wreath mine, Boise County. Contains orthoclase, oligoclase, apatite, biotite, titanite, and magnetite. Described in 18th Ann., Part III, p. 642. Sp. gr. 2.714, 23°.

K. Same as J, but in altered condition. Also described in 18th Ann. Contains sericite, quartz, titanite, apatite, and pyrite, with carbonates of calcium, magnesium, and iron. Sp. gr. 2.774, 23°.

Analyses J and K by George Steiger, record No. 1691.

	I.	J.	K.
SiO_2	69.56	65.23	66.66
Al_2O_3	15.29	16.94	14.26
Fe_2O_3	.86	1.60	.67
FeO	2.06	1.91	2.41
MgO	.69	1.31	.95
CaO	2.81	3.85	3.37
Na_2O	3.97	3.57	none
K_2O	3.36	3.02	4.19
H_2O at 100°	} .86	.18	.36
H_2O above 100°		.88	2.16
TiO_2	.55	.66	.49
P_2O_5	.16	.19	.17
MnO	----------	trace	trace
BaO	----------	.19	none
S	----------	none	.95
CO_2	----------	.25	3.67
	100.17	99.78	100.31
Less O=S	----------	----------	.24
			100.07

COLORADO.

1. DENVER BASIN.

Rocks described by Cross in Mon. XXVII. Analyses A, B, D, and E by L. G. Eakins, C by W. F. Hillebrand. All but A were made in the Denver laboratory.

A. Dolerite, dike near Valmont. Contains augite, plagioclase, olivine, orthoclase, and biotite, with accessory magnetite and apatite. Record No. 1145. P. R. C. 534.

B. Augite separated from A. P. R. C. 105.

C. Basalt, Table Mountain, lower capping sheet. Contains plagioclase, orthoclase, augite, magnetite, and apatite, with olivine much serpentinized. Sp. gr. 2.83, 22.5°.

D. Basalt, earlier flow, south slope of North Table Mountain. Contains augite, olivine, plagioclase, probably orthoclase, magnetite, apatite, and a little biotite. P. R. C. 535.

E. Augite-mica-syenite, from north fork of Turkey Creek, Jefferson County. Contains orthoclase, augite, biotite, rhombic pyroxene, hornblende, plagioclase, quartz, apatite, and magnetite. Sp. gr. 2.857, 29.5°. P. R. C. 532.

	A.	B.	C.	D.	E.
SiO_2	48.25	49.10	52.59	49.69	56.90
Al_2O_3	16.73	7.95	17.91	18.06	18.50
Fe_2O_3	3.99	....	3.81	2.64	.17
FeO	6.28	8.30	5.18	6.19	4.61
MgO	5.77	12.37	4.11	5.73	5.10
CaO	8.32	22.54	7.24	8.24	6.17
Na_2O	3.24	trace	2.94	2.99	2.99
K_2O	4.08	trace	3.83	3.90	4.14
H_2O	1.72	....	1.24	.91	.51
TiO_2	.89	....	.84	.85	.19
P_2O_5	.68	....	.14	.81	.79
MnO	trace	....	trace	.13	trace
BaO	.01	....	....	....	....
Cl	.08	....	.05	.13	trace
SO_3	.12	....	....	....	....
	100.16	100.26	99.88	100.27	100.07

The following rocks from the Denver Basin were analyzed by L. G. Eakins in the Denver laboratory, but the analyses do not appear in the monograph. The subjoined data have been supplied by Whitman Cross.

A. Enstatite-diabase-porphyry, Mount Morrison. Contains labradorite and enstatite in a groundmass of considerable amount, which is colorless and cryptocrystalline, probably feldspathic, and carries magnetite and other indistinct ferritic matter. P. R. C. 533.

B. Augite-andesite, Table Mountain. Contains plagioclase (andesine), with rare augite and biotite, in a groundmass of plagioclase, augite, magnetite, and minor accessories. This rock contained ptilolite in its vesicular equivalent. Described in Proc. Colorado Sci. Soc., 1886, p. 72.

C. Augite-andesite, a pebble from the Denver beds, Table Mountain. A few augite and andesite phenocrysts in a groundmass of oligoclase, orthoclase, and quartz (?) grains, with some augite and magnetite.

	A.	B.	C.
SiO_2	56.74	59.26	59.29
Al_2O_3	18.80	23.63	21.27
Fe_2O_3	.15	.30	3.33
FeO	6.91	.57	1.04
MgO	5.57	.31	1.12
CaO	7.34	5.93	5.25
Na_2O	2.32	4.94	3.39
K_2O	.77	4.78	3.00
H_2O	1.09	.74	1.63
P_2O_5	.20	....	.23
MnO	.07	....	.21
	99.96	100.46	99.76
Sp. gr	2.876, 27°	2.625, 31°	2.596, 14°.5

2. PIKES PEAK DISTRICT.

FIRST GROUP. GRANITE.

Described by E. B. Mathews. Analyses by W. F. Hillebrand, record No. 1470.

A. Granitite, Sentinel Point, western part of Pikes Peak massif. Contains microcline, microcline-perthite, quartz, biotite, a little oligoclase, and accessory fluorite, apatite, zircon, sphene, magnetite, and allanite. P. R. C. 600.

B. Granitite, near road between Florissant and the Platte River. Consists chiefly of microcline in perthitic intergrowth with albite, quartz, and biotite. P. R. C. 606.

C. Porphyritic granitite, south side of Pikes Peak, ridge between Middle and North Beaver creeks. Contains microcline, perthite, orthoclase, oligoclase, quartz, biotite, and accessory apatite, fluorite, zircon, and magnetite. P. R. C. 602.

D. Sheared granite, Currant Creek Canyon, north of Twelvemile Park. Contains perthitic microcline, quartz, muscovite, and sericitic aggregates replacing plagioclase and a part of the microcline. P. R. C. 604.

E. Granite, Currant Creek Canyon, north of Twelvemile Park. Consists chiefly of perthitic microcline, quartz, greenish biotite, muscovite, and plagioclase altered to a sericitic mass. Also flakes of limonite. Accessory minerals rare. P. R. C. 603.

F. Granitite, Middle Beaver Creek, south side of Pikes Peak. Contains microcline, orthoclase, perthitic albite, oligoclase, abundant quartz, biotite, and a little accessory magnetite, fluorite, and zircon. P. R. C. 601.

G. Granite-gneiss, north of Twin Creek. Contains microcline, orthoclase, quartz, biotite, abundant fluorite, and a little sphene and apatite. P. R. C. 605.

	A.	B.	C.	D.	E.	F.	G.
SiO_2	77.03	75.92	75.17	74.40	73.90	73.51	66.90
Al_2O_3	12.00	12.96	12.66	14.43	13.65	13.28	14.86
Fe_2O_3	.76	.33	.23	.89	.28	.94	.93
FeO	.86	1.40	1.40	.22	.42	.97	3.41
MgO	.04	trace	.05	.07	.14	.05	.31
CaO	.80	.15	.82	.58	.23	1.11	1.23
Na_2O	3.21	4.60	2.88	1.76	2.53	3.79	5.56
K_2O	4.92	4.15	5.75	6.56	7.99	5.22	5.02
H_2O at 110°	.14	.16	.16	.15	.16	.16	.16
H_2O above 110°	.30	.32	.66	.92	.33	.62	.31
TiO_2	.13	.05	.10	.12	.07	.18	.43
P_2O_5	trace	trace	.03	.22	.05	trace	.12
MnO	trace	.04	trace	trace	trace	trace	.15
SrO	none	none	trace?	none	none	none	none
BaO	trace	trace	.03	trace	trace	trace	.14
Li_2O	trace	trace	trace	trace	trace	trace	.06
F	.36	.12	.31	.04	none	.55	1.00
CO_2	....	.03	....	....	....	....	....
	100.55	100.23	100.26	100.36	99.75	100.38	100.59
Less O	.15	.05	.13	.02	....	.22	.42
	100.40	100.18	100.13	100.34	....	100.16	100.17

SECOND GROUP. ROCKS OF THE CRIPPLE CREEK DISTRICT.

Described by Cross. Descriptions published, except when otherwise stated, in 16th Ann., Part II, pp. 38–50. Analyses, with two exceptions, which are properly noted, by W. F. Hillebrand, record Nos. 1448, 1453, and 1524.

A. Phonolite, dike in granite northeast of Big Bull Mountain. Contains anorthoclase, nepheline, sodalite, ægirine-augite, some ægirine, biotite, magnetite, and limonite. Nosite not distinguishable. P. R. C. 616.

B. Phonolite, Mitre Peak. Contains sanidine, nepheline, sodalite, ægirine, nosite, and colorless particles which may be låvenite. P. R. C. 608.

C. Phonolite, hill 1 mile south of Straub Mountain. Contains anorthoclase, sanidine, nepheline, sodalite, nosite, analcite, and ægirine, with sometimes ægirine-augite. P. R. C. 612.

D. Phonolite, Rhyolite Mountain. Contains nepheline, nosite, analcite, ægirine, and some ægirine-augite, in a feldspathic groundmass. Sp. gr. 2.52, 23°. P. R. C. 618.

E. Phonolite, between Florissant and Manitou. Analysis by L. G. Eakins, made in the Denver laboratory, inserted here for comparison with the Cripple Creek samples. Described by Cross in Proc. Colorado Sci. Soc., vol. 2, p. 167. Contains sanidine, nepheline, hornblende with accessory pyroxene (?), magnetite, apatite, and sphene. Sp. gr. 2.576, 13°. P. R. C. 637.

F. The portion of E soluble in hydrochloric acid. This portion amounted to 25.39 per cent, and is reduced here to 100. Analysis by Eakins.

	A.	B.	C.	D.	E.	F.
SiO_2	59.00	58.98	58.78	58.64	60.02	44.66
Al_2O_3	20.07	20.54	20.03	19.62	20.98	31.59
Fe_2O_3	1.58	1.65	1.87	2.17	2.21	.95
FeO	.65	.48	.49	.42	.51	....
MgO	.10	.11	.16	.37	trace	....
CaO	1.05	.67	.83	1.24	1.18	2.25
Na_2O	8.34	9.95	9.36	8.39	8.83	18.42
K_2O	5.63	5.31	5.50	5.26	5.72	2.13
H_2O at 100°	.24	.19	.31	.34	.70	....
H_2O above 100°	2.03	.97	1.57	2.40		....
TiO_2	.29	.24	.29	.20	....	....
P_2O_5	.05	.04	.03	.03	trace	....
ZrO_2	.20	.20	.17	.09	....	....
MnO	.12	.26	.15	.20	trace	....
SrO	none	none	none	trace	....	....
BaO	trace	none	none	trace	....	....
Li_2O	trace	trace	trace	trace	....	....
SO_3	.07	.20	.12	trace?	....	....
Cl	.24	.28	.58	.14	trace	....
CO_2	.26	....	....	.23	....	....
	99.92	100.07	100.24	99.74	100.15	100.00

G. Trachytic phonolite, dike on west slope of Bull Cliff. Contains alkali feldspars, nepheline, nosite, sodalite, augite, scanty ægirine, brown hornblende, magnetite, sphene, apatite, and sometimes låvenite. P. R. C. 624.

H. Altered phonolite, Washington shaft, Victor. Contains potash feldspars, with some alteration to muscovite. Crystals of pyrite and fluorite are visible, but nepheline and ægirine have disappeared. Analysis hitherto unpublished. P. R. C. 623.

I. Nepheline-syenite, near the Longfellow mine. Contains alkali feldspars, nepheline, sodalite, augite, some ægirine, hornblende, biotite, sphene, apatite, and magnetite. Sp. gr. 2.68, 23°. Contains 0.02 V_2O_3.

J. Nepheline-basalt, Appie Ellen shaft. Much altered. Rich in olivine, augite, and magnetite. Also contains nepheline, feldspars in small amount, and biotite. Sp. gr. 2.99, 23°.

K. Altered nepheline-basalt, Anna Lee mine. Analysis hitherto unpublished and not discussed.

L. Local facies of a phonolitic mass, Bull Cliff. Contains abundant augite, plagioclase, alkali feldspar, magnetite, and a little red-brown biotite, with a colorless isotropic base in the darker spots. Analysis hitherto unpublished. P. R. C. 627. Contains 0.03 V_2O_3.

	G.	H.	I.	J.	K.	L.
SiO_2	59.38	56.74	54.34	35.03	48.61	49.84
Al_2O_3	19.47	20.30	19.23	9.80	20.74	17.78
Fe_2O_3	1.60	1.06	3.19	5.55	4.29	5.86
FeO	1.19	....	2.11	4.98	.22	2.62
MgO	.36	.23	1.28	9.78	2.11	3.02
CaO	1.96	.57	4.53	15.09	.25	7.35
Na_2O	7.80	.62	6.38	2.04	.16	5.20
K_2O	5.83	13.36	5.14	2.16	.77	3.04
H_2O at 110°	.11	.33	.14	.41	12.10	.34
H_2O above 110°	.69	1.15	1.17	2.05	7.07	2.02
TiO_2	.58	.58	1.09	2.20	3.57	1.43
P_2O_5	.08	.25	.27	1.99	.29	.76
ZrO_2	.10	.07	.07	none	....	.03
Cr_2O_3	....	....	....	....	trace	....
MnO	.15	none	.08	.06	none	.21
SrO	.03	trace	.16	.17	none	.18
BaO	.13	.19	.24	.14	none	.22
Li_2O	trace	trace	trace	trace	(?)	trace
SO_3	.37	....	.07	none	....	none
Cl	.22	....	.28	trace	....	trace
F	....	undet.	undet.	undet.	.63	undet.
CO_2	....	....	none	7.83	....	.52
FeS_2	....	4.65	....	.38	....	....
	100.05	100.10	99.77	99.66	100.81	100.42

THIRD GROUP. MISCELLANEOUS ROCKS.

Analyses, hitherto unpublished, except when otherwise stated, by W. F. Hillebrand, record Nos. 1448, 1453, and 1669. Petrographic data supplied by Whitman Cross. Names marked with a query are provisional designations only.

A. Trachyte?, near Robbins's ranch. Has scattered phenocrysts of alkali feldspar, oligoclase, and biotite in a predominant trachytic groundmass of alkali feldspar, tridymite, particles of residual glass, and ferritic flakes and grains.

B. Trachyte?, Wicher Mountain. Shows biotite and a few glassy feldspars in a groundmass resembling that of A.

C. Andesite?, Bare Hills. Composed mainly of plagioclase and alkali feldspar, with small augites and much ferritic matter. Minute prisms of a yellowish brown amphibole (?) and scales of tridymite are also visible.

D. Pyroxene-andesite?, Wicher Mountain. Contains phenocrysts of plagioclase, a few of augite, minute specks of iddingsite, and flakes of limonite. In the groundmass are plagioclase, orthoclase (?), augite, iddingsite, and hypersthene. In the pores tridymite appears. Contains 0.02 V_2O_3.

E. Plagioclase-basalt?, mesa east of Mac Gulch. Contains plagioclase, augite, olivine, iddingsite, magnetite, biotite, and apatite.

F. Plagioclase-basalt, Saddle Mountain. Phenocrysts of augite and olivine in a groundmass of plagioclase, orthoclase, augite, magnetite, biotite, and apatite. Very fresh. See Cross, Journ. Geol., Vol. 5, p. 684.

	A.	B.	C.	D.	E.	F.
SiO_2	69.52	66.12	62.64	57.48	52.97	48.76
Al_2O_3	15.44	17.21	17.82	18.04	18.31	15.89
Fe_2O_3	1.90	2.43	3.91	5.73	1.86	6.04
FeO	.09	trace	.31	.73	6.73	4.56
MgO	.17	.35	.47	1.17	3.04	5.98
CaO	1.70	2.11	3.22	5.03	6.51	8.15
Na_2O	4.54	4.70	4.47	4.28	3.74	3.43
K_2O	5.04	5.57	4.99	4.15	3.35	2.93
H_2O at 100°	.33	.14	.58	.62	.44	.40
H_2O above 100°	.27	.71	.65	.55	.31	1.48
TiO_2	.23	.29	.59	1.00	1.04	1.65
P_2O_5	.14	.11	.25	.66	.81	.60
ZrO_2	.05	.06	.08	.04	.05	none
MnO	.08	.08	.04	trace	.09	.13
SrO	.04	.05	.07	.12	.14	.06
BaO	.19	.25	.28	.20	.18	.17
SO_3				.16		
CO_2	.17					
	99.90	100.18	100.37	99.96	99.57	100.23

G. Analcite-basalt, from the Basin. Contains phenocrysts of augite, olivine, and analcite. Also magnetite, with subordinate amounts of alkali feldspars, biotite, and apatite.

H. Portion of the analcite-basalt soluble in hydrochloric acid.

I. Augite separated from G.

J. Analcite separated from G. After deduction of 4.22 per cent of substance insoluble in boiling dilute hydrochloric acid, and later removal of liberated silica with weak potash solution. Sixty-two one hundredths per cent of the water goes off over sulphuric acid. A trace of lithia was found.

The analcite-basalt and its fractions are described by Cross in Journ. Geol., vol. 5, p. 684.

	G.	H.	I.	J.
SiO_2	45.59	44.44	49.26	51.24
Al_2O_3	12.98	*a* 20.11	6.01	24.00
Fe_2O_3	4.97	7.50	3.31	1.20
FeO	4.70		4.23	
MgO	8.36	5.81	12.40	.33
CaO	11.09	3.94	21.79	1.62
Na_2O	4.53	8.17	.79	11.61
K_2O	1.04	1.13	.41	1.25
H_2O at 100°	.51	7.91	undet.	9.09
H_2O above 100°	3.40		undet.	
TiO_2	1.32	----------	1.53	----------
P_2O_5	.91	----------	----------	----------
ZrO_2	.03	----------	----------	----------
MnO	.14	trace	undet.	----------
SrO	.12	.16	.06	.06
BaO	.13	(?)	(?)	----------
Cl	.05	.10	----------	trace
	99.87	99.27	99.79	100.40

a Includes P_2O_5 and possible ZrO_2 and TiO_2.

3. SILVER CLIFF AND ROSITA.

Rocks described by Cross, mostly in 17th Ann., Part II, p. 263. Also, partly, in Proc. Colorado Scientific Soc., vol. 2, p. 228. Analyses by L. G. Eakins. Those with record numbers attached were made in the Washington laboratory; all others in the laboratory at Denver.

A. Peridotite, Cottonwood Gulch. Contains hornblende, biotite, hypersthene, olivine, a little plagioclase, apatite, pyrrhotite, and sillimanite (?). P. R. C. 519.

B. Augite-diorite, Mount Fairview, Rosita Hills. Contains augite, biotite, labradorite, and accessory orthoclase, olivine, magnetite, and apatite. Sp. gr. 2.870, 32°. Olivine a subordinate constituent. P. R. C. 526.

C. The same as B, but with orthoclase in much larger amount. Sp. gr. 2.768, 34°. Record No., 1091. P. R. C. 529.

D. Trachyte, Game Ridge. Contains sanidine, plagioclase, a little biotite, magnetite, apatite, and zircon in a groundmass of orthoclase, with a little quartz. Sp. gr., 2.592, 29°. P. R. C. 524.

E. Trachyte, dark-colored dike. Contains more magnetite than D, but otherwise the two are practically identical. Sp. gr. 2.621, 24°.

	A.	B.	C.	D.	E.
SiO_2	46.03	50.47	53.80	66.03	65.41
Al_2O_3	9.27	18.73	20.13	18.49	18.78
Fe_2O_3	2.72	4.19	3.57	2.18	.94
FeO	9.94	4.92	2.63	.22	.72
MgO	25.04	3.48	2.26	.39	.16
CaO	3.53	8.82	5.60	.96	1.58
Na_2O	1.48	4.62	5.20	5.22	5.91
K_2O	.87	3.56	4.49	5.86	5.41
H_2O	.64	.58	.90	.85	1.38
Ti_2O	----------	.51	.43	----------	----------
P_2O_5	.17	.10	.56	.04	trace
MnO	.40	.11	.29	trace	trace
CO_2	----------	trace	----------	trace	----------
Cl	----------	trace	----------	----------	----------
	100.09	100.09	99.86	100.24	100.29

F. Andesite, Pringle Hill. Contains plagioclase, orthoclase, quartz, biotite, augite, magnetite, and apatite, with sometimes a little hornblende. Sp. gr. 2.651, 17.8°. Record No. 1124. P. R. C. 528.

G. Pringle andesite, dike. Like F, but often contains sphene. Sp. gr. 2.690, 28°. P. R. C. 527.

H. Bunker andesite, Lookout Mountain. Contains plagioclase, orthoclase, augite, biotite, hornblende, quartz, magnetite, and apatite. Sp. gr. 2.699, 34°. Record No. 1091.

I. Altered Bunker andesite, Robinson Plateau. Biotite gone, magnetite altered to limonite, feldspars not much attacked. Record No. 1124. Sp. gr. 2.580, 19.7°.

J. Much-decomposed Bunker andesite, ridge near Knickerbocker Hill. Augite, hornblende, and biotite all replaced by decomposition products, plagioclase much muscovitized. Record No. 1124. P. R. C. 592.

	F.	G.	H.	I.	J.
SiO_2	58.94	63.49	57.01	63.88	67.13
Al_2O_3	17.19	18.40	18.41	19.96	18.41
Fe_2O_3	2.63	2.44	3.69	2.21	.45
FeO	1.98	1.09	2.36	.57	.07
MgO	1.52	.66	2.34	.58	.44
CaO	4.45	2.30	4.29	2.03	.55
Na_2O	4.20	5.70	4.95	4.19	4.17
K_2O	3.90	4.62	3.72	3.88	5.28
H_2O	4.53	1.04	2.29	2.63	2.98
TiO_2	.27	trace	.27	....	.30
P_2O_5	.23	trace	.42	....	trace
MnO	.10	.16	.21	trace	trace
CO_2	....	trace	....	....	....
	99.94	99.90	99.96	99.93	99.78

K. Dacite, Bald Mountain, near Rosita. Contains plagioclase, biotite, hornblende, sometimes augite, magnetite, and quartz. Sp. gr. 2.574, 24°. Record No. 1068. P. R. C. 530.

L. Mica-dacite. Contains plagioclase, sanidine, biotite, and quartz. Sp. gr. 2.563, 24°. Record No. 1068.

M. Rhyolite, Pennsylvania Hill. Sp. gr. 2.470, 26°. Record No. 1079. P. R. C. 525.

N. Rhyolite, Round Mountain. Contains sanidine, quartz, some glass, and accessory garnet. P. R. C. 521.

O. Rhyolite, Silver Cliff. Sp. gr. 2.560, 15°. Record No. 1125. P. R. C. 522.

	K.	L.	M.	N.	O.
SiO_2	66.46	67.49	70.87	75.20	75.39
Al_2O_3	17.91	17.76	15.18	12.96	13.65
Fe_2O_3	2.42	2.54	2.18	.37	.38
FeO	.35	.08	.12	.27	.18
MgO	.49	.35	.60	.12	.15
CaO	2.89	1.67	1.58	.29	.51
Na_2O	4.79	5.03	3.47	2.02	1.84
K_2O	3.74	4.40	5.04	8.38	6.81
H_2O	1.01	.52	1.08	.58	1.13
TiO_2	....	....	trace	....	trace
P_2O_5	....	trace	trace	trace	trace
MnO	trace	trace	trace	.03	.14
	100.06	99.84	100.12	100.22	100.18

P. Rhyolitic tuff, a lake-bed deposit east of the Blue Mountains. Mainly composed of glassy rhyolite dust.

Q. Devitrified pitchstone, the gangue of ptilolite, 3 miles southeast of Silver Cliff. Shows feldspar, quartz, and barite. Described by Cross and Eakins in Amer. Journ. Sci., 3d series, vol. 44, p. 96. Record No. 1342. P. R. C. 590.

R Pitchstone, Rosita. Record No. 1033. P. R. C. 531.

S. Pitchstone, Fleetwood tunnel, Silver Cliff. P. R. C. 523.

T. Alteration product of S. Consists mainly of silica and kaolin. Record No. of S and T, 1034. P. R. C. 591.

	P.	Q.	R.	S.	T.
SiO_2	71.02	65.67	73.11	71.56	71.71
Al_2O_3	14.27	13.48	13.16	13.10	12.36
Fe_2O_3	1.22	1.51	.62	.66	1.10
FeO			.23	.28	
MgO	trace	.31	.19	.14	1.21
CaO	1.38	2.41	.54	.74	1.11
Na_2O	2.28	1.52	2.85	3.77	.17
K_2O	3.97	2.42	5.10	4.06	.36
H_2O	6.12	12.27	4.05	5.52	11.97
P_2O_5		trace			
MnO		trace	.14	.16	.17
BaO		.32			
SO_3		.28			
	100.26	100.19	99.99	99.99	100.16

U. Syenite, Silver Cliff. Contains orthoclase and plagioclase in nearly equal amounts, colored by ferric hydroxide, with amphibole, a little biotite, and secondary epidote, calcite, and chlorite. Sp. gr. 2.689, 20°. P. R. C. 520.

V. Quartz-alunite rock, Democrat Hill. About two-thirds quartz and one-third alunite. Record No. 1126. P. R. C. 596.

W. The same, Mount Robinson. About one-fourth alunite. Record No. 1248. P. R. C. 593.

X. Quartz-diaspore rock, Mount Robinson. About 18 per cent diaspore, the rest quartz. Record No. 1167. P. R. C. 594.

Rocks V, W, and X are also described in Amer. Journ. Sci., 3d series, vol. 41, p. 471. These three rocks are decomposition products of rhyolite.

	U.	V.	W.	X.
SiO_2	59.78	65.94	69.67	76.22
Al_2O_3	16.86	12.95	13.72	19.45
Fe_2O_3	3.08	.33	----------	trace
FeO	3.72	.07	----------	----------
MgO	.69	.05	trace	----------
CaO	2.96	.10	.07	trace
Na_2O	5.39	1.19	.34	trace
K_2O	5.01	2.32	2.44	trace
H_2O	1.58	4.47	4.73	3.82
TiO_2	----------	----------	----------	.11
P_2O_5	----------	----------	----------	.13
MnO	.14	trace	----------	----------
BaO	----------	trace	----------	----------
SO_3	----------	12.47	9.27	.29
CO_2	.75	----------	----------	----------
	99.96	99.89	100.24	100.02

The following analyses, all by L. G. Eakins, do not appear in the published memoir just cited. A and B were made in the Denver laboratory. The petrographic details have been supplied by Whitman Cross.

A. Spherulite in rhyolite, ridge west of Mount Tyndall. Mainly composed of quartz and feldspar needles, with some ferritic coloring due to decomposition of trichites.

B. Rhyolitic residual glass, same locality as A.

C. Interspherulitic mass, Rosita. Record No. 1285.

D. Spherulite, Rosita. Record No. 1286.

E, F, G. Spherulites, Silver Cliff. Record Nos. 1285, 1286.

These spherulites, C, D, E, F, and G, are made up of orthoclase needles, with free silica in fibers or grains, or rarely as tridymite.

The "soluble silica" is that which is dissolved by sodium carbonate solution.

	A.	B.	C.	D.	E.	F.	G.
SiO_2	71.27	85.50	74.47	80.61	83.91	79.21	78.77
Al_2O_3	16.02	7.42	13.87	10.94	9.54	12.24	12.46
Fe_2O_3	1.41	1.23					
FeO	.17	.34					
MgO	trace	.82	trace	.09	trace	.11	.09
CaO	.35	.37	.51	.26	.19	.43	.34
Na_2O	5.76	.74	2.10	2.90	.62	2.58	2.12
K_2O	4.08	2.64	7.46	3.02	5.06	5.26	5.84
H_2O	1.14	1.22	1.88	2.20	.69	.66	.70
P_2O_5	trace	none					
MnO	trace	.08					
	100.20	100.36	100.29	100.02	100.01	100.49	100.32
Soluble SiO_2			12.72	11.12	1.06	1.27	1.25

4. BUFFALO PEAKS.

Hypersthene-andesite, described by Cross in Bull. 1. Contains hypersthene, augite, plagioclase, magnetite, and apatite. Sp. gr. 2.742, 16°. Analyses made by W. F. Hillebrand in the Denver laboratory.

A. Hypersthene-andesite. P. R. C. 588.

B, C, D. Hypersthene separated from the rock. Sp. gr. of D, 3.307, 23°. In B and C alkalies were not tested for. In C and D all the iron is given as FeO.

	A.	B.	C.	D.
SiO_2	56.19	51.70	51.16	50.04
Al_2O_3	16.12	1.72	2.15	2.91
Fe_2O_3	4.92	.30		
FeO	4.43	18.00	18.36	17.81
MgO	4.60	25.09	24.25	21.74
CaO	7.00	2.87	3.81	6.70
Na_2O	2.96			.27
K_2O	2.37			
H_2O	1.03			
P_2O_5	.27			
MnO	trace	.36	.36	.12
SrO	trace			
BaO	trace			
Cl	.02			
	99.91	100.04	100.10	99.59

5. LEADVILLE REGION.

Rocks described by Cross in Mon. XII, Appendix A. Analyses made in the Denver laboratory.

A. Porphyry, Mount Zion. Contains orthoclase, plagioclase, quartz, biotite, apatite, magnetite, and zircon. Analysis by L. G. Eakins. P. R. C. 504.

B. White, or Leadville, porphyry. Contains orthoclase, plagioclase, quartz, muscovite, magnetite, apatite, and zircon, with crystals which appear to be rutile and anatase. Sp. gr. 2.680, 16°. Analysis by W. F. Hillebrand. P. R. C. 587.

C. Porphyry, summit of Mount Lincoln. Contains quartz, orthoclase, plagioclase, biotite, apatite, sphene, magnetite, zircon, and allanite. The sample analyzed showed some muscovite, chlorite, and calcite. Sp. gr. 2.670, 16°. Analysis by W. F. Hillebrand. P. R. C. 505.

	A.	B.	C.
SiO_2	73.50	70.74	66.45
Al_2O_3	14.87	14.68	15.84
Fe_2O_3	.95	.69	2.59
FeO	.42	.58	1.43
MgO	.29	.28	1.21
CaO	2.14	4.12	2.90
Na_2O	3.46	2.29	3.92
K_2O	3.56	2.59	2.89
H_2O	.90	2.09	.84
TiO_2			.10
P_2O_5	none		.36
MnO	.03	.06	.09
SrO	trace	trace	.07
BaO		.03	
Li_2O			trace
CO_2		2.14	1.35
Cl		trace	.05
	100.12	100.29	100.09

D. Gray porphyry, Johnson Gulch, near Leadville. Slightly altered. Contains orthoclase, plagioclase, biotite, and quartz, with decomposition products probably derived from original hornblende. Sp. gr. 2.736, 16°. Analysis by Hillebrand.

E. Pink orthoclase crystals from D. Analysis by Hillebrand.

F. Hornblendic porphyrite, lower Buckskin Gulch. Contains plagioclase, orthoclase, quartz, hornblende, biotite, magnetite, apatite, and zircon, with a little secondary calcite and chlorite. Sp. gr. 2.768, 16°. Analysis by Hillebrand. P. R. C. 506.

G. Biotite-porphyrite, dike in gneiss in the North Mosquito amphitheater. Composition like F, but with no horblende, much biotite, and some pyrite. Sp. gr. 2.740, 16°. Analysis by Hillebrand. P. R. C. 507.

	D.	E.	F.	G.
SiO_2	68.10	62.22	56.62	64.81
Al_2O_3	14.97	20.33	16.74	15.73
Fe_2O_3	2.78	....	4.94	1.68
FeO	1.10	....	3.27	2.91
MgO	1.10	....	4.08	2.82
CaO	3.04	2.95	7.39	4.22
Na_2O	3.46	3.45	3.50	3.98
K_2O	2.93	8.31	1.97	1.43
H_2O	1.28	1.90	.92	.62
TiO_2	.07	....	....	.08
P_2O_5	.16	....	trace	.23
MnO	.09	....	.15	.08
SrO	.08	....	trace	trace
CO_2	.92	....	1.15	1.08
Cl	.03	....	....	.04
FeS_2	....	....	....	.90
	100.11	99.16	100.73	100.61

H. Rhyolite (nevadite), from Chalk Mountain. Mainly quartz and feldspar, the latter being sanidine and plagioclase. A little biotite, magnetite, apatite, and zircon are present. Analysis by Hillebrand. P. R. C. 64.

I. Sanidine from H. Analysis by Hillebrand. P. R. C. 64.

	H.	I.
SiO_2	74.45	65.04
Al_2O_3	14.72	20.40
Fe_2O_3	none	....
FeO	.56	....
MgO	.37	....
CaO	.83	.79
Na_2O	3.97	4.11
K_2O	4.53	9.74
H_2O	.66	.29
P_2O_5	.01	....
MnO	.28	....
Li_2O	trace	....
	100.38	100.37

6. TENMILE DISTRICT.

Rocks described by Cross in 14th Ann., page 165. Analyses made in the Denver laboratory, A and C by W. F. Hillebrand, B by L. G. Eakins.

A. Quartz-hornblende-mica-porphyrite, Gold Hill. Contains plagioclase, hornblende, biotite, and quartz, in a groundmass of quartz, orthoclase, and a little plagioclase. P. R. C. 510.

B. Quartz-porphyrite, Sugar Loaf. Contains plagioclase, biotite, and quartz, in a groundmass of quartz and orthoclase. P. R. C. 509.

C. Quartz-porphyrite, Chicago Mountain. Contains plagioclase, orthoclase, biotite, and quartz. P. R. C. 508.

	A.	B.	C.
SiO_2	63.66	67.29	68.30
Al_2O_3	17.05	15.78	16.24
Fe_2O_3	1.97	1.86	1.60
FeO	2.62	1.97	1.63
MgO	1.99	.72	1.05
CaO	3.89	2.36	2.79
Na_2O	4.13	3.77	3.90
K_2O	3.09	3.55	3.52
H_2O at 110° H_2O above 110°	1.19	2.10	.71
TiO_2	undet.	none	undet.
P_2O_5	.27	.28	.13
MnO	.14	.21	.12
SrO	.08	none	.04
BaO	----------	----------	trace
Li_2O	none	trace	trace
CO_2	----------	.27	----------
	100.08	100.16	100.03

The following rocks were also analyzed in the Denver laboratory, but the analyses are hitherto unpublished. Petrographic data furnished by Whitman Cross.

A. Granite-prophyry, McNulty Gulch. Contains phenocrysts of orthoclase, oligoclase, andesine, quartz, biotite, and altered hornblende, in a groundmass of quartz, orthoclase, and magnetite. Accessory sphene, allanite, apatite, and zircon, and a little secondary chlorite are also present. Analysis by W. F. Hillebrand. P. R. C. 586.

B. Granite-porphyry, Jefferson tunnel. Contains orthoclase, oligoclase, quartz, and biotite, in a groundmass of mainly quartz and orthoclase; also accessory magnetite, apatite, zircon, and allanite. Chlorite appears as a decomposition product of biotite, and calcite and magnetite are present in small amounts. Analysis by Hillebrand.

C. Same as B. Analysis by L. G. Eakins. P. R. C. 583.

D. Diorite-porphyry, Copper Mountain. Contains oligoclase, hornblende, and biotite, in a groundmass of quartz, orthoclase, plagioclase, and magnetite; also accessory zircon, sphene, and apatite, and a little secondary chlorite and epidote. Analysis by Eakins. P. R. C. 585.

E. Diorite-porphyry, McNulty type. Contains oligoclase, andesine, hornblende, biotite, and magnetite, in a groundmass of orthoclase, plagioclase, quartz, magnetite, apatite, allanite, and sphene; also secondary chlorite, epidote, and calcite. Analysis by Eakins. P. R. C. 584.

	A.	B.	C.	D.	E.
SiO_2	68.60	65.94	65.51	67.01	63.02
Al_2O_3	16.21	16.00	17.01	18.03	17.61
Fe_2O_3	1.67	.60	none	.66	1.78
FeO	1.57	1.74	2.79	.72	2.76
MgO	1.05	1.02	.90	.84	1.63
CaO	2.61	2.87	3.16	3.99	3.30
Na_2O	3.29	3.85	3.82	4.42	4.72
K_2O	3.88	4.56	4.67	3.53	3.23
H_2O	.92	1.13	1.78	.91	2.03
P_2O_5	.21	.23	.13	.10	.16
MnO	.09	.14	....	.09	trace
SrO	trace	trace	....	....	....
BaO	....	....	....	.10	.08
CO_2	.19	1.55	....	....	....
Cl	.03	.03	trace	....	....
S	....	....	.38	....	....
FeS_2	....	.60	....	....	....
	100.32	100.26	100.15	100.40	100.32
Sp. gr	2.640, 27°	2.672, 21°	2.666, 26°	....	2.689, 16°5

7. ELK MOUNTAINS.

Analyses made by L. G. Eakins in the Denver laboratory, and hitherto unpublished. Petrographic data supplied by Whitman Cross.

A. Rhyolite, East Mountain, Crested Butte district. Phenocrysts of orthoclase, oligoclase, quartz, and biotite, in a microspherulitic and cryptocrystalline groundmass. P. R. C. 514.

B. Rhyolite, Round Mountain, Crested Butte district. Small phenocrysts of quartz, sanidine, biotite, and oligoclase, in a groundmass of quartz and orthoclase. P. R. C. 513.

C. Diorite, Brush Creek, Gunnison County. Contains several varieties of plagioclase, with orthoclase, quartz, hornblende, biotite, augite, sphene, apatite, and magnetite. P. R. C. 93.

	A.	B.	C.
SiO_2	74.84	71.56	62.71
Al_2O_3	14.05	14.91	17.06
Fe_2O_3	.17	1.47	3.79
FeO	.31	1.04	2.74
MgO	trace	.08	1.78
CaO	1.57	1.98	5.51
Na_2O	3.66	3.78	3.54
K_2O	3.14	4.94	2.96
H_2O	2.33	.44	.24
P_2O_5	----------	trace	none
MnO	----------	----------	trace
	100.07	100.20	100.33
Sp. gr	2.38, 17°	2.59, 18°	2.791, 30°

8. WEST ELK MOUNTAINS.

Rocks described by Cross in 14th Ann., p. 165.

A. Hornblende-mica-porphyrite, Cliff Creek. Contains plagioclase, hornblende, and biotite, in a groundmass of quartz, feldspar, and mica. Analysis by W. F. Hillebrand, record No. 1429.

B. Porphyrite, Storm Ridge. Contains plagioclase, biotite, hypersthene, hornblende, and augite, in a groundmass of quartz and orthoclase. Analysis by L. G. Eakins, record No. 1238. P. R. C. 517.

C. Porphyrite-diorite, Mount Marcellina. Contains plagioclase, hornblende, and a little biotite, in a groundmass of quartz and orthoclase. Analysis by T. M. Chatard, record No. 1238. P. R. C. 516.

D. Quartz-porphyrite, Mount Carbon. Contains plagioclase, orthoclase, biotite, hornblende, augite, and quartz. Analysis by Chatard, record No. 1238. P. R. C. 518.

E. Quartz-porphyrite, Crested Butte. Contains plagioclase, orthoclase, hornblende, biotite, quartz, and a little augite. Analysis made by Eakins in the Denver laboratory. P. R. C. 515.

	A.	B.	C.	D.	E.
SiO_2	63.05	61.42	62.85	65.36	65.71
Al_2O_3	15.58	17.69	16.21	15.48	18.30
Fe_2O_3	2.92	4.24	3.08	3.09	1.19
FeO	2.11	1.74	1.46	1.21	1.53
MgO	1.70	1.81	1.47	1.53	.98
CaO	4.15	5.29	4.72	4.14	2.17
Na_2O	3.77	3.14	3.49	3.58	5.00
K_2O	3.66	3.19	3.10	3.41	3.95
H_2O at 100°	.55	.97	.29	.82	1.39
H_2O above 100°	1.38		2.03	.70	
TiO_2	.60	.37	.41	.52	undet.
P_2O_5	.27	.14	.48	.25	....
MnO	.12	.19	.15	.19	.02
SrO	.07	....	....	....	....
BaO	.13	.09	.11	.08	....
Li_2O	trace	....	....	....	....
	100.06	100.28	99.85	100.36	100.24

9. SAN JUAN REGION.

Rocks collected by Whitman Cross, who supplies the petrographic data. Hitherto unpublished.

A. Rhyolitic vitrophyre, near Del Norte, Rio Grande County. Reported by Cross as containing phenocrysts of oligoclase, quartz, biotite, and augite in a dark, fresh, glassy groundmass, the latter being predominant. Analysis made by Eakins in the Denver laboratory. Sp. gr. 2.423, 14°. P. R. C. 598.

B. Rhyolite, Summit district, Rio Grande County. Large phenocrysts of sanidine, with smaller ones of oligoclase and biotite, in a groundmass of orthoclase, quartz, oligoclase, biotite, and magnetite. Analysis by Eakins, made in the Denver laboratory. Sp. gr. 2.489 14°. P. R. C. 164.

C. Augite-diorite, Sultan Mountain, San Juan County. Contains plagioclase, orthoclase, quartz, augite, biotite, magnetite, and apatite. Some chlorite and epidote as alteration products. Analysis by L. G. Eakins in the Denver laboratory. Sp. gr. 2.751, 14°.

D. Augite-diorite, Stony Mountain, Ouray County. Analysis by Eakins in the Denver laboratory. Sp. gr. 2.891, 13.5°. P. R. C. 199.

	A.	B.	C.	D.
SiO_2	68.61	68.85	63.91	52.05
Al_2O_3	16.43	17.01	17.07	17.96
Fe_2O_3	.73	1.78	4.39	4.09
FeO	1.52	.65	1.51	6.33
MgO	.05	trace	.81	5.03
CaO	1.79	1.62	4.47	8.64
Na_2O	2.82	3.44	3.48	2.99
K_2O	4.65	5.11	3.74	1.61
H_2O	3.35	1.79	.33	.97
P_2O_5	....	....	.21	.31
MnO	....	trace	....	.43
	99.95	100.25	99.92	100.41

E. Diorite, La Plata Mountains. Contains augite, hornblende, plagioclase, and orthoclase in large amount, with biotite, quartz, sphene, apatite, and magnetite as subordinate constituents. Also secondary chlorite, muscovite, and calcite. Analysis by W. F. Hillebrand, record No. 1640. Sp. gr. 2.79, 21°.

F. Diorite-porphyry, La Plata Mountains. Contains phenocrysts of hornblende, plagioclase, occasional quartz, sphene, apatite, and magnetite, in a groundmass of orthoclase, plagioclase, and quartz. Also secondary epidote, chlorite, and calcite. Analysis by Hillebrand, record No. 1636. Sp. gr. 2.677, 24°. A trace of sulphur is present.

G. Syenite, between Tirbircio and Schurman gulches, La Plata Mountains. Contains much alkali feldspar, some oligoclase, augite, biotite, and hornblende, with a little titanite, magnetite, and apatite, Analysis by H. N. Stokes, record No. 1764. Sp. gr. 2.704, 25°.

H. Monzonite, Babcock Peak, La Plata Mountains. Contains orthoclase and plagioclase in about equal amounts, with augite and hornblende, and a little quartz, titanite, magnetite, and apatite. Analysis by Stokes, record No. 1764. Sp. gr. 2.767, 26°.

I. Porphyritic lamprophyre, allied to camptonite, Snowstorm Peak, La Plata Mountains. Contains numerous phenocrysts of green hornblende, augite, and plagioclase, in a groundmass of plagioclase, orthoclase, augite, magnetite, and apatite. Some secondary calcite. Analysis by Hillebrand, record No. 1640. Sp. gr. 2.906, 21°.

	E.	F.	G.	H.	I.
SiO_2	55.53	60.44	59.79	57.42	47.25
Al_2O_3	16.78	16.65	17.25	18.48	15.14
Fe_2O_3	4.06	2.31	3.60	3.74	5.05
FeO	3.35	3.09	1.59	2.10	4.95
MgO	3.00	2.18	1.24	1.71	6.87
CaO	6.96	4.22	3.77	6.84	9.98
Na_2O	4.31	5.18	5.04	4.52	2.39
K_2O	3.57	2.71	5.05	3.71	2.60
H_2O at 110°	.09	.36	.19	.08	.40
H_2O above 110°	.55	1.07	.39	.28	2.12
TiO_2	.95	.60	.67	.86	1.22
P_2O_5	.47	.29	.35	.36	.25
V_2O_3	.02	.02	....	....	.05
NiO, CoO	trace	none	....	....	.02
MnO	.16	.13	.20	.09	.17
SrO	.11	.11	.11	.08	.05
BaO	.13	.12	.14	.15	.08
Li_2O	trace	trace	trace	trace	[illegible]
CO_2	.09	.48	.72	none	1.[illegible]
SO_3	....	....	.04	none	....
Cl	....	....	trace	.03	....
FeS_2	.04	....	....	....	none
	100.17	99.96	100.14	100.45	100.46

J. Porphyritic lamprophyre, allied to camptonite, Indian Trail Ridge, La Plata quadrangle. Contains phenocrysts of green hornblende and colorless dioxide in a subordinate groundmass of plagioclase, orthoclase (?), augite, magnetite, and apatite. Much secondary calcite and some serpentine. Analysis by W. F. Hillebrand, record No. 1640. Sp. gr. 2.912, 19.5°.

K. Lamprophyre, allied to camptonite, Black Face, Telluride quadrangle. Consists of a fine felt of plagioclase, augite, and brown hornblende microlites, with flakes of biotite, and a cryptocrystalline part, which is probably in large degree orthoclase. Some magnetite and apatite. Analysis by Hillebrand, record No. 1719. Sp. gr. 2.783, 22°.

L. Quartz monzonite, northeast of San Miguel Peak, Telluride quadrangle. Contains orthoclase and plagioclase in about equal amounts, with abundant quartz and much less augite, hornblende, biotite, magnetite, and apatite. Analysis by H. N. Stokes, record No. 1764. Sp. gr. 2.720, 34°.

M. Gabbroitic facies of a diorite-monzonite stock, Ophir Needles, Telluride quadrangle. Contains abundant labradorite, with augite, hypersthene, biotite, orthoclase, magnetite, apatite, and a very little quartz. Analysis by Stokes, record No. 1764. Sp. gr. 2.860, 33°.

N. Gabbro-porphyry, pass south of Mount Sneffels, Telluride quadrangle. Contains numerous phenocrysts of labradorite or bytownite, in a groundmass of plagioclase, orthoclase (?), augite, hypersthene, biotite, magnetite, and apatite. Analysis by Stokes, record No. 1764. Sp. gr. 2.949, 26.5°.

	J.	K.	L.	M.	N.
SiO_2	43.98	55.65	65.70	56.93	47.32
Al_2O_3	13.30	17.04	15.31	17.03	16.71
Fe_2O_3	3.67	2.81	2.54	3.67	6.92
FeO	6.92	5.17	1.62	4.54	5.94
MgO	7.03	3.42	1.62	3.30	5.69
CaO	10.66	6.82	2.56	6.51	8.51
Na_2O	2.15	3.27	3.62	3.19	2.70
K_2O	1.64	2.29	4.62	2.58	2.02
H_2O at 110°	.42	.46	.17	.13	.24
H_2O above 110°	1.52	1.49	.42	.45	1.04
TiO_2	1.18	.90	.72	1.03	1.50
P_2O_5	.32	.37	.33	.44	.96
MnO	.22	.20	trace	.10	.08
NiO, CoO	.03	none	....	....	....
SrO	.05	.05	.03	.06	.06
BaO	.06	.08	.12	.08	.07
Li_2O	trace	trace	trace	none	trace
CO_2	6.46	....	none	none	none
SO_3	....	none	.12	none	.19
Cl	....	....	.03	trace	trace
FeS_2	.54	....	....	....	....
	100.15	100.02	99.53	100.04	99.95

10. MISCELLANEOUS ROCKS.

A. Rhyolite, east bank of Arkansas River, Nathrop. Described by Cross in Proc. Colorado Sci. Soc., vol. 2, p. 69. Contains quartz and sanidine in a groundmass mainly of quartz and alkali feldspar. This rock carries topaz and spessartite in its lithophysae. Analysis made by L. G. Eakins in the Denver laboratory. Sp. gr. 2.602, 29°.

B. Granite, Platte Canyon. Described by E. B. Mathews in Bull. 150, p. 172. Contains microcline, quartz, biotite, oligoclase, and fluorite. Apatite, zircon, magnetite, hematite, limonite, epidote, and rutile (?) are sometimes present. Analysis by H. N. Stokes, record No. 1314.

C. Hornblende-porphyrite, Hermano Peak, Sierra El Late. Described by Cross in 14th Ann., p. 165. Contains plagioclase, hornblende, rare quartz, and a little biotite. Analysis by W. F. Hillebrand, record No. 1429.

D. Hornblende-porphyrite, Ute Peak, Sierra El Late. Described by Cross in 14th Ann., p. 165. Contains plagioclase, hornblende, and very little augite, in a groundmass of quartz, orthoclase, and plagioclase. Analysis by Hillebrand, No. 1429.

E. Porphyritic augite-diorite, Lone Cone, San Miguel Mountains. Described by Cross in 14th Ann., p. 165. Contains plagioclase, augite, hornblende, and biotite, in a groundmass of quartz, orthoclase, and plagioclase. Inclusions of magnetite and apatite in the augite. Analysis by Hillebrand, No. 1429.

	A.	B.	C.	D.	E.
SiO_2	69.89	77.02	62.65	59.42	59.19
Al_2O_3	17.94	11.63	16.68	16.79	18.00
Fe_2O_3	.39	.32	2.35	3.23	3.07
FeO	.52	1.09	2.63	3.29	2.32
MgO	.14	.14	1.43	2.24	1.41
CaO	trace	1.24	4.96	5.57	6.55
Na_2O	4.21	2.85	4.45	4.15	4.01
K_2O	4.38	5.21	2.75	2.82	2.74
H_2O at 100°	} 2.07	} .35	.27	.27	.46
H_2O above 100°			.66	.79	1.06
TiO_2	----	----	.42	.68	.58
P_2O_5	trace	----	.28	.35	.29
MnO	.23	trace	.16	.13	.19
SrO	----	----	.11	.07	.13
BaO	----	----	.13	.14	.18
Li_2O	trace	----	trace	trace	trace
CO_2	----	----	----	.44	----
	99.77	99.85	99.93	100.38	100.18

F. Tinguaite?, Two Buttes. Collected by G. K. Gilbert; petrographic data supplied by Whitman Cross. Consists chiefly of pale-green augite, hornblende, apatite, magnetite, and occasional crystals of alkali feldspar, in an obscure, largely isotropic groundmass. Sp. gr., 2.79, 25°.

G. Pyroxene from F. Sp. gr., 3.43, 28°.

H. Portion of F soluble in $\frac{1}{40}$ nitric acid.

I. Syenitic lamprophyre?, Two Buttes. Collected by Gilbert; description by Cross. Chief constituents, diopside, alkali feldspar, considerable biotite, magnetite, and olivine. The ferromagnesian minerals predominate. Sp. gr., 2.88, 29°. Also contains 0.03 V_2O_3.

J. Pyroxene from I. Sp. gr., 3.45, 25°.

K. Portion of I soluble in $\frac{1}{40}$ nitric acid.

Analyses F to K by W. F. Hillebrand, record No. 1604.

	F.	G.	H.	I.	J.	K.
SiO_2	47.61	47.54	13.27	50.41	51.27	1.58
Al_2O_3	14.26	4.14	9.40	12.30	3.05	1.00
Fe_2O_3	4.90	5.64	....	5.71	3.08	none
FeO	4.07	6.42	trace	3.06	4.34	.87
MgO	2.62	10.05	trace	8.69	14.21	1.22
CaO	8.71	21.57	1.70	7.08	22.58	.68
Na_2O	6.70	1.38	5.41	.97	.67	undet.
K_2O	4.08	.12	.66	7.53	.06	undet.
H_2O at 110°	.26	none	undet.	.46	none	none
H_2O above 110°	1.89	undet.	undet.	1.80	undet.	undet.
TiO_2	1.38	3.00	....	1.47	.70	....
P_2O_5	1.38	....	1.34	.46	....	.46
ZrO_2	.18	none	....	none	none	....
Cr_2O_3	trace?	trace?	....	trace	none	....
NiO	trace	trace	....	.04	.03	....
MnO	.30	.36	trace	.15	.28	trace
SrO	.36	none	.11	.06	none	(?)
BaO	.41	none	none	.23	none	none
Li_2O	trace	trace	(?)	trace	....	....
SO_2	1.17	....	.77	none	....	....
S	.03	....	.03	none	....	....
Cl	.37	....	.37	trace	....	trace
F	trace	....	trace	trace?	....	....
	100.68	100.21	33.06	100.42	100.27	5.81

UTAH.

I. ROCKS FROM THE TINTIC DISTRICT.

Described by Tower and Smith in 19th Ann., Part III, pp. 609 et seq. Analyses by Stokes, record No. 1746.

A. Gray, porphyritic rhyolite, south of Pinyon Creek. Contains phenocrysts of sanidine, quartz, biotite, plagioclase, and hornblende; the last mineral sparingly. Also tridymite, magnetite, apatite, zircon, and a small amount of glassy residue.

B. Quartz-porphyry, Swansea mine. Phenocrysts of feldspar and quartz, the orthoclase somewhat altered. Microscopic biotite occurs sparingly. Also contains magnetite, apatite, zircon, a little chlorite, and secondary pyrite.

C. Andesite, Tintic Mountain. Phenocrysts of biotite and feldspar. Contains plagioclase, chiefly labradorite, augite, biotite, hypersthene, magnetite, and apatite, in a dark-gray glass.

D. Granular monzonite, Iron Duke mine. Contains orthoclase, plagioclase, quartz, hornblende, biotite, magnetite, apatite, zircon, and titanite, with a little chlorite and epidote.

E. Altered monzonite, near Tintic mine. Feldspar and ferromagnesian minerals completely altered. Rutile is present; quartz seems to have been added.

	A.	B.	C.	D.	E.
SiO_2	69.18	71.56	60.17	59.76	71.14
Al_2O_3	14.36	14.27	15.77	15.77	16.22
Fe_2O_3	2.52	} .89	3.42	3.77	.94
FeO	.57		2.95	3.30	.16
MgO	.70	.42	2.52	2.16	1.12
CaO	1.88	1.18	4.69	3.88	.25
Na_2O	3.58	3.00	2.96	3.01	.07
K_2O	5.00	4.37	4.16	4.40	4.96
H_2O at 110°	.35	.36	.25	.31	.49
H_2O above 110°	.25	.79	1.23	1.11	2.74
TiO_2	.69	.38	.87	.87	.75
P_2O_5	.26	.13	.40	.42	.32
Cr_2O_3	trace	trace	none	none	none
V_2O_3	.01	.01	.01	.02	.02
MnO	.10	trace	.11	.12	trace
BaO	.09	.28	.14	.09	.05
SrO	trace	trace	.09	trace	trace
Li_2O	trace	none	trace	trace	trace
CO_2	none	none	none	.78	none
S	none	....	none	none	....
SO_3	none	....	none	none	.26
FeS_2	....	2.29	....	....	....
Cl	trace	.06	.04	.04	trace
	99.54	99.99	99.78	99.81	99.49

Fluorine was not looked for in the analyses.

2. ROCKS FROM THE HENRY MOUNTAINS.

A. Porphyry. Not hitherto published. Reported by J. S. Diller as containing prominent plagioclase with some augite and hornblende in a crystalline groundmass of quartz and orthoclase. Analysis by R. B. Riggs, record No. 728.

B. Augite-porphyrite, dike, north spur of Mount Pennell. Contains hornblende, augite, and plagioclase in a feldspathic groundmass.

C. Hornblende-porphyrite, Mount Hillers. Contains plagioclase, hornblende, quartz, and magnetite.

Analyses B and C by W. F. Hillebrand, record No. 1428. Rocks described by Cross in 14th Ann., p. 165.

	A.	B.	C.
SiO_2	63.16	60.98	62.88
Al_2O_3	17.21	19.09	17.13
Fe_2O_3	2.43	1.76	1.86
FeO	2.30	1.15	2.58
MgO	1.27	.65	1.48
CaO	6.27	3.67	5.39
Na_2O	4.70	6.70	4.50
K_2O	1.84	3.53	2.25
H_2O at 100°	....	.48	.16
H_2O above 100°	.69	.44	.42
TiO_2	.21	.36	.51
P_2O_5	.12	.10	.26
MnO	trace	.15	.16
SrO	trace?	.28	.12
BaO	.09	.43	.16
Li_2O	trace	trace	trace
CO_2	....	.52	....
SO_3	trace	....	....
	100.29	100.29	99.86

3. MISCELLANEOUS ROCKS.

A. Rhyolite, Thomas Range. Analysis made by L. G. Eakins in the Denver laboratory. Described by Cross in Proc. Colo. Sci. Soc., vol. 2, p. 69. Contains phenocrysts of quartz and sanidine in a groundmass mainly made up of quartz and alkali feldspar.

B. Rhyolitic glass or pitchstone, edge of Gold Mountain mining district, 8 miles north of west from Marysvale. Identified by Whitman Cross, but not published. Sp. gr. 2.25 at 23.5°. Analysis by W. F. Hillebrand, record No. 1833.

	A.	B.
SiO_2	74.49	70.17
Al_2O_3	14.51	11.83
Fe_2O_3	.57	.93
FeO	.32	none
MgO	trace	.06
CaO	1.03	.76
Na_2O	3.79	3.85
K_2O	4.64	3.74
H_2O	.64	8.72
TiO_2	....	.17
MnO	trace	....
Li_2O	trace	....
	99.99	100.23

NEW MEXICO.

1. BASALTS FROM RIO GRANDE CANYON.

Described by Iddings, Bull. 66; also in Amer. Journ. Sci., 3d series, vol. 36, p. 220. Contain plagioclase, augite, olivine, and magnetite. A, B, and C contain quartz also; D is quartzless. Analyses by L. G. Eakins, record Nos. 847, 850.

A. Light gray, dense. P. R. C. 548.
B. Greenish black, dense.
C. Dark red, vesicular. P. R. C. 549.
D. Gray dense. P. R. C. 547.

	A.	B.	C.	D.
SiO_2	52.27	52.37	51.57	52.38
Al_2O_3	17.68	17.01	17.72	18.79
Fe_2O_3	2.51	1.44	6.24	2.88
FeO	5.00	5.89	1.78	4.90
MgO	6.05	6.86	4.91	4.91
CaO	8.39	7.59	8.82	7.70
Na_2O	4.19	3.51	3.59	3.99
K_2O	1.58	1.59	1.99	1.76
H_2O	.82	1.29	.64	.53
TiO_2	1.49	1.60	1.43	1.22
P_2O_5	....	....	....	.56
MnO	.23	.32	.45	.18
BaO	.06	.06	.16	.11
CO_2	trace	.37	.58	....
Cl	trace	trace	....	....
	100.27	99.90	99.88	99.91

2. MOUNT TAYLOR REGION.

Rocks received from J. S. Diller. Analyses by T. M. Chatard, record Nos. 219, 227, 228, 235, 271, 268, and 269. Not hitherto published. Petrographic details furnished by Diller.

A. Lava, canyon on east side of San Mateo Mountain.

B. Phonolitic andesite, canyon on east side of San Mateo Mountain. Contains feldspar and corroded augite, with sometimes olivine, in a groundmass of feldspar and a green ferromagnesian silicate.

C. Mica-andesite, canyon on east side of San Mateo Mountain. Shows prominent plagioclase, with augite and biotite.

D. Mica-andesite, 6 miles northeast of Grant's. Principally plagioclase and biotite, with less epidote, quartz, sphene, and carbonates.

E. Basalt, 6 miles northeast of Grant's. Contains chiefly plagioclase, augite, and olivine, with much magnetite.

F. Augite from E.

G. Feldspar from E. Analysis on three-fourths gramme of material.

	A.	B.	C.	D.	E.	F.	G.
SiO_2	68.40	65.51	65.78	49.80	47.54	47.06	52.54
Al_2O_3	17.99	16.89	17.32	15.33	16.73	7.77	31.26
Fe_2O_3	2.66	1.41	3.68	....	6.69	1.30	....
FeO	1.63	2.52	.46	7.44	6.67	8.15	....
MgO	.49	.39	.47	6.61	6.38	13.52	.28
CaO	.67	1.19	1.66	7.19	8.74	19.33	12.34
Na_2O	4.54	6.42	5.23	2.71	2.81	.33	3.55
K_2O	3.54	5.02	4.64	4.36	1.10	.11	.42
H_2O	.52	.16	.14	1.38	.36	.20	.26
TiO_2	....	.92	.27	2.67	2.76	1.82	undet.
P_2O_5	....	.07	.13	.73	.51	.06	....
Cr_2O_3	....	....	....	....	....	trace	....
MnO	.21	.31	.32	.30	.19	.20	....
(CoNi)O	....	....	....	....	....	traces	....
BaO	....	....	....	....	.03	....	trace ?
CO_2	....	....	....	2.56	(?)	....	....
	100.65	100.81	100.10	101.08	100.51	99.85	100.65

3. COLFAX COUNTY.

Descriptions, hitherto unpublished, supplied by Whitman Cross. Analyses by W. F. Hillebrand, record No. 1719.

A. Phonolite, Pleasant Valley. Contains much nephelite, some ægirite, alkali feldspar, a scanty dust of magnetite, and a few decomposed grains of noselite or sodelite. Sp. gr. 2.619, 22°; 40.8 per cent soluble in dilute (1:40) nitric acid, of which soluble portion 43.5 per cent is silica.

B. Pyroxene-andesite, Sierra Grande. Contains augite, less hypersthene, microliths of plagioclase, apatite, magnetite, and a smoky-brown glassy base. Sp. gr. 2.635, 21°.

C. Plagioclase-basalt, end of San Rafael flow. Contains plagioclase, augite, olivine, with much iddingsite, magnetite, and apatite. Sp. gr. 2.970, 21.5°.

D. Nepheline-basanite, Ciruella. Contains augite, olivine, nephelite, plagioclase, magnetite, apatite, and a little biotite. Sp. gr. 3.122, 22°. 0.55 per cent K_2O and 2.10 per cent Na_2O soluble in 1:40 nitric acid.

	A.	B.	C.	D.
SiO_2	56.24	60.16	48.35	42.35
Al_2O_3	21.43	15.34	15.47	12.29
Fe_2O_3	2.01	3.07	4.80	3.89
FeO	.55	2.18	7.58	7.05
MgO	.15	3.41	8.15	13.09
CaO	1.38	5.79	8.81	12.49
Na_2O	10.53	3.88	3.09	2.74
K_2O	5.74	2.59	.95	1.04
H_2O at 110°	.12	.25	.28	.32
H_2O above 110°	.86	1.79	.73	1.50
TiO_2	.26	.84	1.33	1.82
P_2O_5	.06	.46	.33	.99
ZrO_2	.09	.01	none	none
Cr_2O_3	none	trace?	trace	.10
V_2O_3	------	------	------	.04
NiO, CoO	none	trace	.02	.03
MnO	.08	.08	.21	.21
SrO	.03	.08	.03	.09
BaO	.08	.14	.06	.10
Li_2O	trace	trace	trace	trace
SO_3	.10	.08	.07	.05
S	.03	trace	trace	trace
Cl	.12	undet.	undet.	undet.
F	trace	undet.	undet.	undet.
	99.86	100.15	100.26	100.19

4. MISCELLANEOUS ROCKS.

A. Obsidian, Obsidian Hill camp, Tewan Mountains. Described by Iddings, 7th Ann., p. 292. A rhyolitic obsidian, containing grains of iron oxide and a few microscopic feldspars. Resembles that from Obsidian Cliff in the Yellowstone National Park. Analysis by L. G. Eakins, record No. 851. Sp. gr., 2,352, 23°.5.

B. Trachyte (?), from Los Cerillos. Described by Diller, Bull. 42, p. 39. Analysis by F. W. Clarke, record No. 346. Rock composed chiefly of orthoclase, with a considerable amount of biotite, epidote, pyrite, and limonite, and some amorphous substance. It is the matrix or gangue rock of the Los Cerillos turquois.

	A.	B.
SiO_2	76.20	56.68
Al_2O_3	13.17	16.62
Fe_2O_3	.34	6.28
FeO	.73	----------
MgO	.19	.79
CaO	.42	.59
Na_2O	4.31	1.03
K_2O	4.46	11.18
H_2O	.33	3.28
TiO_2	trace	.22
P_2O_5	----------	.73
FeS_2	----------	2.21
MnO	.10	1.02
CuO	----------	trace
	100.25	100.63

ARIZONA.

A, B, C, D. Mica-basalt, Santa Maria Basin. See Iddings, Bull. Phil. Soc. Washington, vol. 12, p. 212. Not fully described. Analyses by W. F. Hillebrand, record No. 1261.

E. Hornblende-porphyrite, Sierra Carrizo. Described by Cross, 14th Ann., p. 165. Contains plagioclase and hornblende, in a groundmass of quartz and orthoclase. Analysis by Hillebrand, No. 1429.

	A.	B.	C.	D.	E.
SiO_2	49.36	55.35	57.04	57.48	63.18
Al_2O_3	16.35	12.91	13.66	14.09	16.47
Fe_2O_3	2.93	4.67	4.96	5.21	2.36
FeO	8.55	2.06	1.77	1.35	2.28
MgO	7.06	6.29	4.43	3.49	1.33
CaO	10.08	5.77	6.23	6.05	4.77
Na_2O	2.67	2.65	3.08	3.00	4.40
K_2O	.82	4.86	4.95	4.69	2.93
H_2O at 100°	.22	2.67	1.11	1.20	.27
H_2O above 100°	.65	1.18	1.10	1.37	.60
TiO_2	.98	.87	.94	.94	.60
P_2O_5	.30	.58	.63	.65	.28
MnO	.19	.08	.17	.09	.15
NiO, CoO	.05	.05	.07	.08	....
SrO	none	trace	trace	trace	.09
BaO	.04	.19	.22	.23	.15
Li_2O	none	trace	trace?	none	trace
	100.25	99.98	100.36	99.92	99.86

F. Typical hypersthene-andesite, San Francisco Mountains. Not described. Analysis by T. M. Chatard, record No. 270.

G. Recent lava, 2 miles south of Mount Trumbull. Not describe . Analysis by L. G. Eakins, record No. 1024.

	F.	G.
SiO_2	64.82	45.30
Al_2O_3	18.27	14.95
Fe_2O_3	3.48	1.98
FeO	.56	9.32
MgO	.85	8.29
CaO	2.89	8.87
Na_2O	5.05	4.27
K_2O	2.67	1.27
H_2O	.20	.85
TiO_2	.56	2.66
P_2O_5	.23	2.23
MnO	.20	trace
	99.78	99.99

NEVADA.

1. ROCKS FROM WASHOE.

Described by Hague and Iddings, Bull. 17. Analyses by F. A. Gooch, record Nos. 119, 129. FeO not separately determined.

A. Rhyolite, south-southeast of McClellan Peak. Contains feldspars, orthoclase predominating over plagioclase, quartz, mica, and hornblende.

B. Dacite, spur northeast of McClellan Peak. More plagioclase than orthoclase, much mica, less hornblende, little quartz.

	A.	B.
SiO_2	73.07	69.96
Al_2O_3	11.78	15.79
Fe_2O_3	2.30	2.50
MgO	.39	.64
CaO	2.02	1.73
Na_2O	1.19	3.80
K_2O	6.84	4.12
Ignition	2.24	1.53
	99.83	100.07

2. ROCKS FROM EUREKA.

Described by Hague and Iddings, Mon. XX.

A. Basalt, summit of Richmond Mountain. Red, porous. Contains augite, less hypersthene, feldspars, and magnetite, in a glassy base, with accessory olivine and quartz. Analysis by J. E. Whitfield, record No. 424.

B. Andesitic perlite, south of Carbon Ridge. Contains plagioclase, hornblende, biotite, quartz, hypersthene, augite, magnetite, apatite, and zircon, with a glassy base. Analysis by W. H. Melville, record No. 1240.

	A.	B.
SiO_2	50.38	65.13
Al_2O_3	19.83	15.73
Fe_2O_3	6.05	2.24
FeO	2.00	1.86
MgO	5.36	1.49
CaO	10.03	3.62
Na_2O	2.15	2.93
K_2O	1.76	3.96
H_2O at 105°	1.37	.52
H_2O above 105°		1.91
TiO_2	none	.58
P_2O_5	none	.23
NiO	....	.07
MnO	.38	trace
Li_2O	trace	....
SO_3	.83	....
	100.14	100.27

CALIFORNIA.

1. MOUNT SHASTA.

Description of rocks furnished by J. S. Diller, who also describes A, B, and C in Bull. 150, pp. 221, 227.

A. Hornblende-andesite, Black Butte, west base of Shasta. Contains plagioclase and hornblende in a microlitic groundmass. The latter carries hypersthene, magnetite, and amorphous matter. Analysis by W. H. Melville, record No. 1346. P. R. C. 84.

B. Hypersthene-andesite, older flow, west base of Shasta. Contains plagioclase, hypersthene, magnetite, and glass. Analysis by Melville, No. 1346.

C. Hypersthene-andesite, like B, same locality, later flow. Analysis by Melville, No. 1346. P. R. C. 87.

D. Hornblende-andesite, late flow, eastern side of Shasta. Contains small crystals of plagioclase and hornblende in a dark groundmass. Thin section not examined. Analysis by H. N. Stokes, record No. 1532.

E. Ophitic basalt from near the McCloud River, south of Mount Shasta. A gray cellular rock. Thin section not examined. Analysis by Stokes, No. 1532.

F. Andesite basalt, Delta, Shasta County. Much plagioclase and a few hypersthene crystals in a groundmass chiefly of feldspar, pyroxene, magnetite, and trace of olivine. Analysis by Melville, No. 1346.

	A.	B.	C.	D.	E.	F.
Si_2O	64.48	64.52	63.03	61.58	47.94	55.08
Al_2O_3	19.28	18.31	17.72	16.96	18.90	18.93
Fe_2O_3	1.40	.90	2.27	1.75	2.21	2.02
FeO	1.78	2.51	1.92	2.85	8.59	5.56
MgO	1.64	2.35	3.63	3.67	8.21	5.17
CaO	5.06	5.11	5.97	6.28	9.86	8.40
Na_2O	4.41	4.64	3.92	3.94	2.81	4.23
K_2O	1.12	1.25	1.06	1.28	.29	.74
H_2O at 110°	.06	.20	.44	.24	.39	.29
H_2O above 110°				1.06	.74	
TiO_2	undet.	undet.	undet.	.49	.57	trace
P_2O_5	....	....	....	.22	.15	....
MnO	....	....	....	trace	trace	....
SrO	....	....	....	trace	none	....
BaO	....	....	....	.03	none	....
Li_2O	....	....	....	trace	trace	....
	99.23	99.79	99.96	100.35	100.66	100.42

The following rocks are from Shasta County, but not within either the Mount Shasta or the Lassen Peak areas. Collected by J. S. Diller, who furnishes the petrographic data.

A. Dacite-porphyry, east fork of Clear Creek, 9 miles above French Gulch. Contains conspicuous phenocrysts of plagioclase, a few of quartz, and smaller ones of biotite and pyroxene, in a groundmass of quartz and feldspar. Analysis by J. E. Whitfield, record No. 970.

B. Dacite-porphyry, Smiths Gulch, 6 miles up Clear Creek from French Gulch. Contains phenocrysts of plagioclase, quartz, biotite, and hornblende, in a groundmass chiefly of quartz and feldspar. Analysis by Whitfield, No. 971. Also described by J. P. Iddings in Bull. 150, p. 233. P. R. C. 90.

C. Diorite, from Ono. Not described. Analysis by T. M. Chatard, record No. 1107.

	A.	B.	C.
SiO_2	66.30	64.24	68.10
Al_2O_3	17.55	18.67	15.18
Fe_2O_3	2.19	1.40	1.34
FeO	.55	1.96	1.70
MgO	.97	1.48	2.06
CaO	3.12	4.11	4.66
Na_2O	5.15	4.14	3.71
K_2O	2.45	1.71	1.48
H_2O	1.25	1.18	.55
TiO_2	trace	.76	.35
P_2O_5	.15	.08	.18
MnO	trace	trace	.20
BaO	----------	----------	.06
SO_3	.28	.22	----------
Cl	----------	.25	----------
	99.96	100.20	99.57
Less O	----------	.05	
		100.15	

2. LASSEN PEAK REGION.

Rocks collected by J. S. Diller, who has furnished the petrographic ta. Nearly all are from the area covered by the Lassen Peak atlas eet of the U. S. Geological Survey. The quartz basalts have been scribed by Diller in Bull. 79, and partly in Amer. Journ. Sci., 3d ries, vol. 33, p. 49. The analyses are so numerous that it seems best divide them into subordinate groups.

1ST. RHYOLITES.

A. Rhyolite, a short distance northwest of Willow Lake, near the Geyser, Plumas County. A light-gray rock with occasional phenocrysts of quartz and feldspar in a granular groundmass of the same materials. Analysis by W. F. Hillebrand, record No. 414.

B. Rhyolite, 2 miles northwest of Deer Creek Meadows, Tehama County. Shows many small crystals of quartz, feldspar, and biotite in a spherulitic groundmass. Analysis by Hillebrand, No. 415.

C. Rhyolite, Slate Creek, west of Deer Creek Meadows. Composed wholly of spherulites, some of which include crystals of feldspar or biotite. Analysis by Hillebrand, No. 416.

D. Rhyolite, summit of Mount Stover, Plumas County. Composed almost wholly of spherulites, with a few crystals of feldspar and hornblende. Analysis by Hillebrand, No. 417.

E. Rhyolite, near Slate Creek, west of Deer Creek Meadows. A pearlite, composed chiefly of little glass balls, with a few spherulites, and crystals of feldspar and biotite. Analysis by Hillebrand, No. 418.

F. Rhyolite, 1½ miles northeast of Clipper Mills, on tramway to Rock Creek, Shasta County. A spherulitic rock containing a few microscopic particles of feldspar and hornblende. Analysis by Hillebrand, No. 678.

G. Rhyolite-tuff, divide between the west fork of Willards Creek and the stage road, in Lassen County. Elevation, 5,800 feet. Composed almost wholly of fine angular particles of clear glass. Analysis by George Steiger, record No. 1427.

Materials for A to F dried at 110° previous to analysis.

	A.	B.	C.	D.	E.	F.	G.
SiO_2	74.24	74.65	73.62	72.40	73.64	74.60	70.01
Al_2O_3	14.50	14.11	14.24	14.81	13.44	13.41	12.61
Fe_2O_3	1.27	1.08	.93	.81	.60	1.28	1.47
FeO	.67	.29	.67	.88	.74	.30	.50
MgO	.25	.20	.33	.47	.26	.26	.72
CaO	.11	.80	1.07	1.94	1.26	1.08	1.06
Na_2O	3.00	2.81	3.25	3.91	3.51	3.38	1.94
K_2O	3.66	4.59	4.28	3.90	4.50	4.50	5.12
H_2O at 100°							2.37
H_2O above 100°	2.04	1.40	1.29	.59	1.99	.85	4.68
TiO_2	.20	.21	.21	.18	.11	.16	
P_2O_5	.07	trace	.02	.03	.06	.03	.04
MnO	.06	.11	.08	.07	.06	.06	trace
SrO	trace	trace	trace	.04	.02	none	
BaO	.18	.08	.10	.10	.11	.11	
Li_2O	none	none	none	trace	trace	trace	
SO_3	.03						
	100.28	100.33	100.09	100.13	100.30	100.02	100.52

2D DACITES AND ANDESITES.

A. Gray dacite, Lassen Peak. Contains hornblende, biotite, plagioclase, quartz, scarce pyroxene, magnetite, apatite, and a glassy base. Analysis by T. M. Chatard, record No. 111. P. R. C. 82.

B. Secretion in dacite, Lassen Peak. Composed chiefly of plagioclase and hornblende. Analysis by Chatard, No. 110.

C. Reddish dacite, Lassen Peak. Essentially like A. Analysis by Chatard, No. 110. P. R. C. 82.

D. Dacite, near the timber line, west base of Lassen Peak. Small phenocrysts of plagioclase and hornblende, with a few of quartz, in a reddish-gray groundmass containing much amorphous matter. Analysis by W. F. Hillebrand, record No. 668. P. R. C. 82.

E. Secretion in D. Composed essentially of plagioclase and hornblende. Analysis by Hillebrand, No. 669. P. R. C. 82.

Rocks A, C, D, and E described by Diller in Bull. 150, p. 217.

	A.	B.	C.	D.	E.
SiO_2	69.51	58.97	68.20	68.32	55.14
Al_2O_3	15.75	18.60	16.98	15.26	19.10
Fe_2O_3	3.34	5.94	3.75	1.66	6.16
FeO				1.26	.54
MgO	2.09	6.89	2.07	1.32	4.23
CaO	1.71	2.84	4.33	3.26	8.36
Na_2O	3.89	3.05	2.98	4.27	3.71
K_2O	3.34	2.24	1.52	2.81	1.04
H_2O	.56	1.35	.44	1.37	.91
TiO_2				.31	.52
P_2O_5	trace	undet.		.12	.18
MnO				.04	.11
SrO				trace	.07
BaO				.07	trace
Li_2O				trace	trace
	100.19	99.88	100.27	100.07	100.07

F. Dacite, east end of Chaos, northwest base of Lassen Peak. The youngest dacite of the region. Contains quartz, feldspar, biotite, and hornblende, embedded in a clear pumiceous glass. Analysis by W. F. Hillebrand, record No. 670. Described by Diller in Bull. 150, p. 218.

G. Secretion in F. Consists chiefly of plagioclase and hornblende, with some olivine and clear glass. Analysis by Hillebrand, No. 671.

H. Dacite (?), west side of old crater rim near the Thumb, at the head of Mill Creek, Shasta County. Shows phenocrysts of hornblende, plagioclase, and pyroxene, and apparently of quartz, in a gray, microlitic groundmass. Analysis by Hillebrand, No. 674.

I. Streaked dacite, falls of south fork of Bear Creek, Shasta County. Contains plagioclase with a little sanidine, hornblende, quartz, magnetite, some pyroxene inclusions, and glass base. Analysis by R. B. Riggs, record No. 524. P. R. C. 80. Described by Diller in Bull. 150, p. 213.

J. Dacite-tuff, Rice's quarry, 6 miles southeast of Paskenta, Tehama County. Clear glass, with fragments of quartz, feldspar, and hornblende. Analysis by George Steiger, record No. 1427.

	F.	G.	H.	I.	J.
SiO_2	68.72	53.35	63.81	68.10	65.78
Al_2O_3	15.15	19.22	17.07	15.50	14.87
Fe_2O_3	1.16	3.28	2.11	3.20	1.27
FeO	1.76	4.48	2.15	none	1.00
MgO	1.28	4.86	2.28	.10	1.89
CaO	3.30	9.76	4.97	3.02	2.41
Na_2O	4.26	2.89	4.08	4.20	2.58
K_2O	2.78	.99	1.96	3.13	2.71
H_2O at 100°					2.87
H_2O above 100°	.74	.77	1.03	2.72	4.32
TiO_2	.31	.56	.38	.15	
P_2O_5	.09	.10	.10	.03	.08
MnO	.11	.15	.09	trace	trace
SrO	.03	.03	.03	trace	
BaO	.07	trace ?	.04	.06	
Li_2O	trace	trace	trace	none	
	99.76	100.44	100.10	100.21	99.78

K. Pyroxene-andesite, west end of Butte Mountain, Plumas County. Prominent phenocrysts of pyroxene and minute ones of plagioclase, in a dark groundmass containing much globulitic matter. Analysis by W. F. Hillebrand, record No. 411.

L. Pyroxene-andesite, south base of Burney Butte, Shasta County. Numerous small phenocrysts of plagioclase and a few of pyroxene, in a gray groundmass containing much amorphous matter. Analysis by R. B. Riggs, record No. 684.

M. Hornblende-andesite, Tuscan Buttes, 7 miles east of Red Bluff. A few small phenocrysts or fragments of hornblende, in a groundmass consisting mainly of plagioclase and gray microlitic matter. Analysis by Hillebrand, No. 412.

N. Hornblende-andesite, near Buntingville, Lassen County. A few phenocrysts of hornblende in a groundmass consisting mainly of small feldspars. Analysis by T. M. Chatard, record No. 413.

O. Hornblende-andesite, northwest summit, head of Burney Creek, Shasta County. Inconspicuous plagioclase and, rarely, olivine, in a groundmass of plagioclase and pyroxene. Numerous dark spots are due to altered hornblende. Analysis by Riggs, No. 683.

Rocks in this group dried at 105° before analysis.

	K.	L.	M.	N.	O.
SiO_2	55.53	62.44	60.93	67.89	60.04
Al_2O_3	17.63	16.39	18.56	17.29	17.43
Fe_2O_3	2.81	4.66	2.68	2.39	5.39
FeO	3.59	1.00	2.19	.21	.53
MgO	5.85	2.65	2.37	.66	3.51
CaO	8.74	6.22	6.63	3.01	6.65
Na_2O	3.09	3.16	3.79	5.11	4.15
K_2O	.92	2.25	1.33	1.69	1.24
H_2O	1.24	1.02	.90	1.34	.90
TiO_2	.56	.31	.61	.21	.49
P_2O_5	.21	.05	.18	.12	.04
MnO	.08	trace	.10	.12	.08
SrO	.06	trace	.12	.04	?
BaO	.02	.03	.02	.03	.04
Li_2O	none	trace	none	....	trace
SO_3	....	trace	....	....	trace
	100.33	100.18	100.41	100.11	100.49

P. Hypersthene-andesite, 1 mile west of summit on Bidwell's road, Butte County. Rich in small phenocrysts of plagioclase and pyroxene, mostly hypersthene, in a groundmass of the same minerals, with magnetite, and probably some amorphous matter. Analysis by W. F. Hillebrand, record No. 410.

Q. Hypersthene-andesite, old crater at head of Mill Creek. Contains small phenocrysts of plagioclase and hypersthene, in a groundmass of plagioclase, pyroxene, magnetite, etc. Some greenish pseudomorphs suggest former olivine. Analysis by T. M. Chatard, record No. 409.

R. Hypersthene-andesite, 2 miles south of Suppans Mountain, Tehama County. Abundant plagioclase and hypersthene, with traces of hornblende, in a microlitic groundmass. Analysis by Hillebrand, No. 672.

S. Secretion in R. Composed chiefly of plagioclase and hypersthene, with some quartz and amorphous matter. Analysis by Hillebrand, No. 673.

T. Hypersthene-andesite, westb ase of Suppans Mountain, near Lassen Peak, Tehama County. Contains numerous microscopic crystals of plagioclase and hypersthene, in a microlitic groundmass. Analysis by Hillebrand, No. 676.

Rocks dried at 100° to 110° before analysis.

	P.	Q.	R.	S.	T.
SiO_2	55.20	57.11	63.47	57.04	58.08
Al_2O_3	18.68	17.78	16.75	19.11	18.37
Fe_2O_3	3.14	3.54	2.15	4.37	2.92
FeO	4.42	2.74	2.75	2.48	3.38
MgO	4.59	3.41	3.04	3.94	3.35
CaO	8.02	7.21	5.72	7.34	7.05
Na_2O	3.66	3.81	3.94	3.48	3.66
K_2O	1.01	1.86	1.62	1.16	1.33
H_2O	.51	.98	.55	1.09	1.09
TiO_2	.92	.95	.37	.47	.44
P_2O_5	.24	.26	.13	.08	.16
MnO	.14	.33	.09	.12	.13
SrO	.02	trace?	.04	.02	.02
BaO	.03	.03	.04	trace?	.03
Li_2O	none	....	trace	trace	trace
	100.58	100.01	100.66	100.70	100.01

U. Hypersthene-andesite, 1 mile southwest of Thumb, head of Bailey Creek, near Lassen Peak. Abundant but inconspicuous plagioclase and hypersthene, in a microlitic groundmass containing many small crystals of plagioclase. Analysis by W. F. Hillebrand, record No. 675.

V. Hypersthene-andesite, west summit of Crater Peak, Shasta County. Microphenocrysts of feldspar and hypersthene in a groundmass consisting largely of the same minerals, with some amorphous matter. Analysis by Hillebrand, No. 679.

W. Hypersthene-andesite, north slope of Crater Peak. Phenocrysts of plagioclase and hypersthene in a groundmass containing much dark amorphous matter. Analysis by Hillebrand, No. 680.

X. Secretion in W. Composed chiefly of plagioclase, hypersthene, and a globulitic base. Analysis by Hillebrand, No. 681.

Y. Andesitic tuff, Stillwater Creek, 8 miles northeast of Redding. Contains plagioclase, hornblende, rare hypersthene, magnetite, and glass. Fragments of andesite are inclosed. Analysis by W. H. Melville, record No. 1346. Described by Diller in Bull. 150, p. 211.

Rocks dried at 100° to 110° before analysis.

	U.	V.	W.	X.	Y.
SiO_2	59.84	68.12	61.17	53.85	69.51
Al_2O_3	16.81	16.24	17.74	18.53	15.61
Fe_2O_3	1.88	1.26	1.78	1.96	.56
FeO	3.60	2.08	3.51	5.30	1.27
MgO	3.85	1.35	2.76	5.88	.61
CaO	6.30	3.80	5.90	9.66	2.80
Na_2O	3.63	3.89	3.79	2.98	3.43
K_2O	2.13	2.54	1.71	.74	2.81
H_2O	1.04	.40	.83	.45	3.63
TiO_2	.57	.25	.45	.50	trace
P_2O_5	.19	.14	.14	.05	....
Cr_2O_3	trace?	none	none	trace	....
MnO	.14	.10	.12	.12	....
SrO	.02	.02	.04	.04	....
BaO	.07	.09	.06	.03	....
Li_2O	trace	trace	trace	trace	....
	100.07	100.28	100.00	100.09	100.23

3D. BASALTS.

The quartz-basalts are described by Diller in Bull. 79. That from Mitylene was analyzed for comparison with the Cinder Cone series.

A. Quartz-basalt, Cinder Cone, 10 miles northeast of Lassen Peak. Contains plagioclase, pyroxene (mostly hypersthene), olivine, quartz, and much unindividualized base; the latter about 25 per cent. Magnetite is also present; augite occurs sparingly. Analysis by W. F. Hillebrand, record No. 407. P. R. C. 96. Also described in Bull. 150, p. 252.

B. Volcanic bomb from quartz-basalt, Cinder Cone. Analysis by Hillebrand, No. 665.

C. Lapilli from quartz-basalt, Cinder Cone. Analysis by Hillebrand, No. 667. P. R. C. 96. Also described in Bull. 150, p. 249.

D. Volcanic sand, one-half mile northeast of Cinder Cone. Analysis by Hillebrand, No. 663.

E. White pumiceous inclosure from quartz-basalt, Cinder Cone. Analysis by Hillebrand, No. 664. Mainly glass.

Rocks dried at 100° to 110° before analysis.

	A.	B.	C.	D.	E.
SiO_2	57.25	56.70	56.53	55.93	79.49
Al_2O_3	16.45	15.75	17.50	17.34	11.60
Fe_2O_3	1.67	1.29	1.35	1.50	.33
FeO	4.72	5.32	5.03	5.20	.49
MgO	6.74	7.16	5.94	7.29	.09
CaO	7.65	7.67	8.07	8.04	1.64
Na_2O	3.00	3.36	3.51	3.32	4.04
K_2O	1.57	1.56	1.55	1.35	1.52
H_2O	.40	.30	.27	.26	.68
TiO_2	.60	.65	.54	undet.	undet.
P_2O_5	.20	.20	.15	undet.	undet.
Cr_2O_3	....	trace	trace	....	....
MnO	.10	.19	.12	undet.	none
SrO	trace	trace	trace?	(?)	(?)
BaO	.03	.03	trace	(?)	(?)
Li_2O	none	trace	trace	(?)	(?)
	100.38	100.18	100.56	100.23	99.88

F. Quartz-basalt, one-half mile south of Cinder Cone, on border of ava field. Analysis by Hillebrand, No. 666.

G. Quartz-basalt, west end of Lake Bidwell, on border of Cinder Cone lava field. Contains a few grains of quartz, much olivine and plagioclase, less pyroxene, and a globulitic base. Analysis by Hillebrand, No. 661.

H. Quartz-basalt, Silver Lake, near Lassen Peak. Contains occasional grains of quartz, much feldspar and olivine, less pyroxene, and a brownish base. Analysis by Hillebrand, No. 662.

I. Quartz-basalt, resting on dacite, near west base of Lassen Peak. Analysis by Hillebrand, No. 677.

J. Quartz-basalt, island of Mitylene, coast of Asia Minor. Analysis or comparison with the Cinder Cone series, by T. M. Chatard, record No. 845.

Rocks F to I dried at 100° to 110° before analysis.

	F.	G.	H.	I.	J.
SiO_2	54.56	56.18	57.59	56.51	56.58
Al_2O_3	16.04	16.59	16.49	18.10	14.88
Fe_2O_3	.95	1.51	1.22	4.26	2.31
FeO	6.07	5.51	4.89	2.68	3.04
MgO	8.71	7.26	7.72	4.52	3.76
CaO	8.89	7.64	7.40	8.15	8.69
Na_2O	3.05	3.58	3.62	3.23	3.36
K_2O	1.18	1.47	.99	1.15	2.18
H_2O at 105°	....	....	....	....	.69
H_2O above 105°	.28	.42	.86	.69	1.43
TiO_2	.53	undet.	undet.	.48	.77
P_2O_5	.18	undet.	undet.	.14	.15
Cr_2O_3	trace	....	....	trace	trace?
MnO	.17	undet.	undet.	.11	.16
SrO	trace	(?)	(?)	.04	....
BaO	.03	(?)	(?)	.04	.07
Li_2O	trace	(?)	(?)	trace	....
CO_2	....	....	....	....	2.32
	100.64	100.16	100.78	100.10	100.39

K. Recent basalt, Pit River. Rich in feldspar and augite, poor in olivine. Partial analysis by F. W. Clarke, record No. 109.

L. Basalt, 1 mile southeast of Paynes Creek, on the road from Red Bluff to Lassen Peak. A normal basalt, rather rich in olivine. Analysis by T. M. Chatard, record No. 405.

M. Basalt, summit of Inskip Crater, 25 miles east of Red Bluff. Mainly feldspar and augite, with a few phenocrysts of olivine. Analysis by Hillebrand and Chatard, record No. 406.

N. Basalt from the cone at south base of Burney Butte, Shasta County. Composed of plagioclase and augite, with some olivine and a globulitic base. Analysis by R. B. Riggs, record No. 685.

O. Basalt, near eastern end of rim of Crater Peak, Shasta County. Contains plagioclase and pyroxene, some of the latter being hypersthene with a trace of olivine. Analysis by R. B. Riggs, record No. 682.

P. Hornblende-basalt, Kosk Creek, near its mouth, by the great bend of Pit River, Shasta County. Contains abundant phenocrysts of hornblende, with a few of plagioclase, pyroxene, and olivine, in a groundmass of plagioclase, augite, and magnetite. The hornblendes are deeply corroded, and some have disappeared, leaving groups of magnetite grains to mark their former presence. Analysis by L. G. Eakins, record No. 1022. Described by Diller in Amer. Geologist, vol. 19, p. 253.

Rocks dried at 105° to 110° before analysis, except in the case of the rock marked L.

	K.	L.	M.	N.	O.	P.
SiO_2	51.92	47.93	50.89	52.63	52.95	44.77
Al_2O_3	19.76	18.51	16.76	17.62	18.25	17.82
Fe_2O_3	} 11.21	2.07	3.86	6.49	4.36	5.05
FeO		7.25	4.69	3.10	4.19	6.95
MgO	3.38	9.03	8.49	5.64	4.93	8.22
CaO	9.30	11.14	11.72	8.62	8.73	10.36
Na_2O	2.16	2.28	2.61	3.38	3.57	2.13
K_2O	.60	.24	.32	1.73	.77	.92
H_2O	1.54	.76	.41	.79	1.47	2.64
TiO_2	....	.73	.79	.07	.66	.53
P_2O_5	....	.11	.09	.47	trace	.72
MnO	....	.20	.13	trace	.12	trace
SrO	....	....	....	trace	trace	....
BaO	....	....	trace	.04	.01	....
Li_2O	....	....	....	trace	(?)	....
CO_2	....	none	....	....	....	....
SO_3	....	....	....	trace	trace	....
	99.87	100.25	100.76	100.58	100.01	100.11

3. PLUMAS COUNTY.

Other rocks from this county are described under the heading of the Lassen Peak area. The following rocks, with two exceptions, were collected by H. W. Turner, who supplies the descriptions:

A. Granite, dike in serpentine, south slope of Grizzly Hill. Described by Turner in Amer. Geologist, vol. 17, p. 375. Contains quartz, albite, and muscovite. Analysis by H. N. Stokes, record No. 1562. P. R. C. 757.

B. Meta-rhyolite, near Tower Rock, Grizzly Mountains. Described by Turner in 14th Ann., p. 441. Contains porphyritic quartz, feldspar, and pyrite, in a fine groundmass. Analysis by W. F. Hillebrand, record No. 1273. P. R. C. 741.

C. Meta-rhyolite, near Greenville. Collected by Diller, who finds phenocrysts of quartz in a groundmass chiefly of quartz and feldspar. Analysis by Hillebrand, record No. 1458.

D. Granodiorite, southwest base of Mount Ingalls. Description supplied by Turner. Contains plagioclase, quartz, orthoclase, brown mica, green hornblende, iron oxide, and a little apatite, sphene, and epidote. Analysis by Hillebrand, record No. 1456. P. R. C. 727.

E. Granodiorite, Spanish Peak. Description supplied by Turner. Contains plagioclase, quartz, orthoclase, biotite, hornblende, iron ore, and apatite; also abundant secondary epidote and chlorite. Analysis by Stokes, record No. 1562. P. R. C. 756.

	A.	B.	C.	D.	E.
SiO_2	76.00	73.25	72.77	67.33	59.68
Al_2O_3	14.88	13.25	13.00	15.93	17.09
Fe_2O_3	.65	....	1.28	1.90	2.85
FeO	.10	1.74	2.65	1.59	2.75
MgO	.06	.28	.67	1.63	3.54
CaO	.19	2.23	2.47	4.09	6.62
Na_2O	3.52	2.69	4.95	3.76	3.87
K_2O	2.77	3.79	.34	2.46	1.31
H_2O at 100°	.20	.07	.07	.19	.15
H_2O above 100°	1.42	1.03	1.16	.66	1.00
TiO_2	.04	trace	.22	.36	.65
P_2O_5	.11	trace	.04	.11	.25
MnO	trace	trace	.08	.09	trace
SrO	....	trace?	trace	trace	trace
BaO	trace	trace	trace	.08	.04
Li_2O	....	trace	trace	trace	trace
CO_2	....	1.05	.47	....	.20
SO_3	trace	....	....	....	trace
Cl	trace	....	....	....	.03
F	trace	....	....	....	....
FeS_2	....	.58	....	....	....
	99.94	99.96	100.17	100.18	100.03

F. Rhyolite, 3½ miles southwest of Grizzly Peak. Description furnished by Turner. Contains sanidine, with less quartz and biotite, in a glassy groundmass. Analysis by Hillebrand, record No. 1461, P. R. C. 776.

G. Hornblende-andesite, 4 miles from Pilot Peak. Described by Turner in 14th Ann., p. 441. Contains plagioclase and hornblende in a groundmass carrying grains of magnetite. Analysis by Hillebrand, record No. 1432. P. R. C. 716.

H. Hornblende-pyroxene-andesite, southwest base of Mount Ingalls. Description supplied by Turner. Contains plagioclase, rhombic pyroxene, augite, brown hornblende, and magnetite, with much glass in the groundmass. Analysis by Hillebrand, record No. 1456. P. R. C. 728.

I. Hypersthene-andesite, Franklin Hill. Description supplied by Turner. Contains plagioclase, rhombic pyroxene, augite, and magnetite. Probably no glass. Analysis by Hillebrand, record No. 1548, P. R. C. 754.

	F.	G.	H.	I.
SiO_2	71.39	60.20	58.47	56.88
Al_2O_3	14.13	17.21	18.80	18.25
Fe_2O_3	.63	3.12	3.34	2.35
FeO	.37	2.69	2.64	4.45
MgO	.08	3.18	2.69	4.07
CaO	1.01	6.04	6.60	7.53
Na_2O	2.89	3.35	3.58	3.29
K_2O	5.69	1.44	2.01	1.42
H_2O at 100°	.42	1.12	.14	.24
H_2O above 100°	3.32	1.18	.92	.50
TiO_2	.17	.57	.51	.45
P_2O_5	.03	.17	.22	.30
MnO	trace	.12	.13	.18
SrO	trace	trace	.05	.04
BaO	.09	.11	.09	.11
Li_2O	trace	trace	trace	trace
	100.22	100.50	100.19	100.06

J. Dolerite, Mount Ingalls. Described by Turner in 14th Ann., p. 441. Contains plagioclase, augite, hypersthene, magnetite, and a few olivines. Analysis by W. F. Hillebrand, record No. 1273. P. R. C. 739.

K. Dolerite, Mount Ingalls. Also in 14th Ann., p. 441. Like J, but with scarcely any olivine. Analysis by Hillebrand, record No. 1432. P. R. C. 740.

L. Basalt, 4 miles southeast of Mount Ingalls. Also in 14th Ann., p. 441. Contains plagioclase, olivine, augite, and magnetite. Analysis by Hillebrand, record No. 1273.

M. Olivine-basalt, 1½ miles from Franklin Hill. Contains plagioclase, augite, partly altered olivine, magnetite, and probably some glass. Description supplied by Turner. Analysis by George Steiger, record No. 1596. P. R. C. 755.

N. Serpentine, Greenville. Described by Diller in Bull. 150, p. 372. Besides serpentine, the rock contains some magnetite and less chromite, with remnants of the pyroxene from which the serpentine was in great part derived. Analysis by W. H. Melville, record No. 1346. P. R. C. 145.

	J.	K.	L.	M.	N.
SiO_2	53.91	52.81	50.56	51.21	39.14
Al_2O_3	17.95	16.60	14.71	17.59	2.08
Fe_2O_3	2.21	2.66	3.54	4.71	4.27
FeO	4.80	6.13	8.90	4.42	2.04
MgO	5.52	6.12	4.07	7.12	39.84
CaO	10.40	10.14	7.58	10.36	trace
Na_2O	2.90	2.79	2.94	2.49	....
K_2O	1.34	1.05	2.10	.91	....
H_2O at 100°	.20	.38	1.06	.58	12.70
H_2O above 100°	.20	.54	1.12	1.07	
TiO_2	.52	.84	1.71	.31	....
P_2O_5	.21	.23	1.14	.09	....
MnO	.10	undet.	.13	trace	....
SrO	trace	trace	trace ?	....	....
BaO	.05	.03	.25	none	....
Li_2O	trace	trace	trace ?	none	....
Chromite	....	....	....	....	.11
	100.31	100.32	99.81	100.86	100.18

4. BUTTE COUNTY.

Rocks from this county are also to be found under the heading of the Lassen Peak region. The following rocks were collected by H. W. Turner, to whom the petrographic data are due. Analyses, with two exceptions, by W. F. Hillebrand, record Nos. 1432, 1456, 1461, and 1548. Analysis G is by H. N. Stokes, record No. 1562.

A. Granodiorite, north side of south fork of Feather River, opposite Enterprise. Described in 14th Ann., p. 441. Contains plagioclase, potash feldspar, quartz, hornblende, brown mica, and accessory minerals. The ferromagnesian minerals are largely altered to chlorite. P. R. C. 720.

B. Granodiorite, 2 miles east of Bangor. Composition like A. The mica is largely altered to chlorite. See 14th Ann., p. 441. P. R. C. 717.

C. Diorite, South Honcut Creek. Description supplied by Turner. Contains feldspar, probably all plagioclase, brown hornblende, and a little chlorite. P. R. C. 775.

D. Quartz-diorite, 4.6 miles south of Table Mountain, on ridge between Butte and Plumas counties. Described in 17th Ann., Part I, p. 521. Contains hornblende, feldspar, quartz, rutile, and a little secondary chlorite and epidote. P. R. C. 758.

E. Amphibole separated from E. Analysis by William Valentine, record No. 1723. Cr_2O_3 determination by Hillebrand.

	A.	B.	C.	D.	E.
SiO_2	70.36	63.43	57.87	54.64	50.08
Al_2O_3	15.47	14.20	16.30	12.06	7.97
Fe_2O_3	.98	1.54	1.71	1.81	2.69
FeO	1.17	4.56	3.86	5.03	6.71
MgO	.87	2.35	5.50	11.86	16.31
CaO	3.18	5.51	5.53	7.74	11.21
Na_2O	4.91	3.49	5.01	2.35	1.22
K_2O	1.71	2.19	.75	1.01	.46
H_2O at 100°	.06	.15	.26	.12	....
H_2O above 100°	1.00	1.50	2.40	2.44	1.40
TiO_2	.20	.73	.53	.61	.76
P_2O_5	.11	.11	.27	.08	trace
V_2O_3	....	....	....	.03	....
Cr_2O_3	....	....	....	....	.16
NiO	....	....	....	.05	....
MnO	trace	.03	.08	.13	.49
SrO	trace	trace	trace	trace	....
BaO	.06	.06	.05	.05	none
Li_2O	trace	none	trace	trace	....
	100.08	99.85	100.12	100.01	100.46

F. Meta-andesite-tuff. Described in 14th Ann., p. 441. Contains plagioclase, augite, epidote, chlorite, and secondary hornblende. P. R. C. 719.

G. Uralite-diorite, 1 mile southeast of Forbestown. Described in 17th Ann., Part I, p. 521. Contains plagioclase, hornblende, and magnetite. P. R. C. 751.

H. Basalt, Oroville, Table Mountain. Described in 14th Ann., p. 441. Contains plagioclase, olivine, augite, and magnetite. P. R. C. 718.

I. Altered peridotite, 5 miles northeast of Strawberry Valley. Largely serpentine, with olivine, hornblende, magnetite, and calcite or dolomite. P. R. C. 742.

	F.	G.	H.	I.
SiO_2	54.66	51.07	50.66	44.81
Al_2O_3	15.85	14.93	13.97	*a* 1.88
Fe_2O_3	1.82	6.44	2.55	1.98
FeO	5.12	5.98	10.20	4.52
MgO	5.64	4.84	4.45	30.91
CaO	8.75	7.89	8.08	6.58
Na_2O	3.46	5.04	3.32	.15
K_2O	.47	.16	1.95	
H_2O at 100°	.25	.24	.27	.15
H_2O above 100°	2.48	1.73	.43	6.88
TiO_2	.67	1.65	2.39	....
P_2O_5	.15	.19	1.01	.02
Cr_2O_3	....	....	....	.29
MnO	.18	.22	.29	.13
NiO	trace?	....	trace	.09
SrO	trace	....	trace	none
BaO	.04	....	.22	none
Li_2O	none	....	none	....
CO_2	.39	....	....	1.79
Cl	....	trace	.02	....
F	....	trace	....	....
SO_3	....	trace	....	....
FeS_2	.09	....	....	....
	100.02	100.38	99.81	100.18

a Includes possible TiO_2.

5. SIERRA COUNTY.

Rocks collected and described by H. W. Turner. See paper in 17th Ann., Part I, p. 521. Additional details, supplied by Turner, are given here. Analyses A to H by W. F. Hillebrand, record Nos. 1456 and 1548. Analysis I by H. N. Stokes, record No. 1514.

A. Granulite (aplite), Yuba Gap, road east of Sierra Buttes. Contains orthoclase, microcline, quartz, plagioclase, some shreds of greenish mica, and a little iron ore, chlorite, and apatite. P. R. C. 730.

B. Granulite (aplite), dike east of Milton. Contains orthoclase, quartz, plagioclase, a little microcline, brown mica, and iron ore. P. R. C. 734.

C. Biotite-quartz-monzonite, Indian Valley. Contains plagioclase, orthoclase, quartz, brown mica, apatite, and iron ore. P. R. C. 737.

D. Quartz-diorite-porphyry, dike in Indian Valley granite. Contains plagioclase, hornblende, biotite, and quartz. P. R. C. 738.

E. Quartz-mica-diorite, large area east of Milton. Contains plagioclase, a turbid feldspar which is apparently not orthoclase, quartz, green hornblende, brown mica, iron ore, and apatite. P. R. C. 732.

	A.	B.	C.	D.	E.
SiO_2	76.03	75.97	68.65	66.65	57.26
Al_2O_3	13.39	13.07	16.34	17.61	16.51
Fe_2O_3	.48	.61	.93	.93	3.27
FeO	.31	.39	1.48	1.67	5.19
MgO	.05	.14	1.29	1.26	3.41
CaO	1.28	1.49	3.07	4.44	6.69
Na_2O	2.98	2.51	4.85	4.59	2.65
K_2O	5.18	5.62	1.85	1.70	2.93
H_2O at 100°	.15	.14	.24	.03	.20
H_2O above 110°	.34	.24	.62	.41	.95
TiO_2	.07	.09	.28	.33	.53
P_2O_5	.03	trace	.15	.18	.30
MnO	trace	trace	.08	.07	.18
SrO	trace	.03	.07	....	.06
BaO	.04	.14	.09	.12	.10
Li_2O	none	trace	trace	trace	trace
	100.33	100.44	99.99	99.99	100.23

F. Diabase-porphyry, dike east of Milton. Contains labradorite and other plagioclase, augite, and hornblende, the last mineral being perhaps secondary. P. R. C. 733.

G. Hypersthene-andesite, point northeast of Goodyears Bar. Contains plagioclase and rhombic pyroxene, a little augite, and scales which seem to represent former biotite, now replaced by magnetite. P. R. C. 731.

H. Hornblende-pyroxene-andesite, dike southeast of Poker Flat. Contains plagioclase, augite, hornblende, magnetite, some glass, and occasional quartz. P. R. C. 736.

I. Quartz-bearing andesite, northwest of Downieville. Contains plagioclase, augite, enstatite, magnetite, occasional quartz, and probably glass. P. R. C. 753.

	F.	G.	H.	I.
SiO_2	51.27	66.94	59.34	60.02
Al_2O_3	12.14	16.49	17.61	16.07
Fe_2O_3	2.51	1.41	3.63	2.17
FeO	6.71	1.87	2.28	3.46
MgO	10.88	1.98	3.50	4.57
CaO	10.32	4.77	6.45	7.01
Na_2O	2.00	3.88	3.40	3.55
K_2O	1.63	1.65	1.94	1.59
H_2O at 100°	.17	.35	.64	.24
H_2O above 100°	1.16	.22	.74	.45
TiO_2	.60	.30	.32	.42
P_2O_5	.21	.12	.25	.17
Cr_2O_3				trace
NiO	.04			
MnO	.21	.13	.12	.10
SrO	trace?	.05	.04	trace
BaO	.07	.07	.11	.08
Li_2O	trace	trace	trace	none
SO_3				.06
	99.92	100.23	100.37	99.96

6. NEVADA CITY AND GRASS VALLEY.

Rocks of a mining district in Nevada County, described by Lindgren in 17th Ann., Part II, p. 1.

A. Granodiorite, 1 mile southeast of Nevada City. Contains hornblende, biotite, quartz, plagioclase, orthoclase, magnetite, apatite, sphene, and pyrite. Analysis by W. F. Hillebrand, record No. 1478.

B. Granodiorite, Kate Hayes Hill, Grass Valley. Contains plagioclase, orthoclase, quartz, hornblende, pyrite, magnetite, apatite, sphene, and zircon. Analysis by Hillebrand, No. 1478.

C. Hornblende-porphyrite, Nevada City. Contains feldspar, hornblende, quartz, epidote, sericite, and biotite. Analysis by H. N. Stokes, record No. 1531.

D. Quartz-porphyrite, New Ophir claim, Grass Valley. Contains plagioclase, quartz, uralite, epidote, and augite, and hornblende altered into chlorite. Analysis by Stokes, No. 1531.

E. Diabase, near Maryland mine, Grass Valley. Contains feldspar, augite, hornblende, ilmenite, pyrrhotite, pyrite, and some chlorite. Analysis by Stokes, No. 1522.

F. Diabase, Grass Valley. Contains feldspar, pyroxene, hornblende, ilmenite, pyrrhotite, pyrite, and chlorite, and probably a little quartz. Analysis by Stokes, No. 1522.

	A.	B.	C.	D.	E.	F.
SiO_2	66.65	63.85	62.09	63.39	51.01	53.19
Al_2O_3	16.15	15.84	16.69	16.58	11.89	17.12
Fe_2O_3	1.52	1.91	1.45	1.41	1.57	4.35
FeO	2.36	2.75	3.76	3.08	6.08	5.16
MgO	1.74	2.07	1.93	2.15	8.87	3.98
CaO	4.53	4.76	6.08	4.76	10.36	9.39
Na_2O	3.40	3.29	3.36	3.47	4.17	2.79
K_2O	2.65	3.08	1.84	2.79	.15	.28
H_2O at 110°	.18	.28	.19	.22	.24	.17
H_2O above 110°	.72	1.65	1.47	1.87	2.09	1.21
TiO_2	.38	.58	.32	.44	.98	1.34
P_2O_5	.10	.13	.39	.14	.17	.13
Cr_2O_3					.04	none
MnO	.10	.07	trace	trace	trace	trace
SrO	trace	trace				
BaO	.07	.06	.10	.11	none	trace
Li_2O	trace	trace				
SO_3			.10			
FeS_2	.02	.04			1.73	.94
CuS (?)					trace	
	100.57	100.36	99.77	100.41	99.35	100.05

G. Wall rock, Federal Loan mine. A siliceous argillite, of sedimentary origin. Contains quartz, feldspar, biotite, pyrrhotite, and a little calcite. Analysis by Hillebrand, No. 1478.

H. Altered wall rock, Providence mine. Derived from granodiorite. Analysis by Hillebrand, No. 1478.

I. Altered wall rock, Providence mine, back vein. Derived from granodiorite and schist. Analysis by Hillebrand, No. 1478.

J. Altered wall rock, North Star mine. Derived from uralite-diabase. Contains quartz, sericite, calcite, pyrite, and sphene. Analysis by Hillebrand, No. 1478.

K. Altered country rock, Idaho mine. Derived from serpentine. Analysis by Hillebrand, No. 1478.

	G.	H.	I.	J.	K.
SiO_2	73.63	60.26	59.76	45.74	36.19
Al_2O_3	10.54	15.73	14.45	5.29	4.93
Fe_2O_3	} 1.87	1.25	1.04	.13	.21
FeO		2.68	3.52	2.06	5.36
MgO	1.84	1.82	2.26	.94	22.94
CaO	2.47	5.44	6.09	23.85	4.60
Na_2O	1.81	1.92	1.12	.11	.16
K_2O	1.89	3.71	3.73	1.29	.06
H_2O at 110°	.11	.33	.26	.22	.18
H_2O above 110°	1.07	2.54	2.58	1.07	2.87
TiO_2	.52	.42	.46	.36	.16
P_2O_5	.13	.12	.16	.07	.05
MnO	trace?	.04	.09	.26	.12
NiO					.10
SrO	trace	trace	trace?	none	trace
BaO	.12	.07	.05	trace	trace
Li_2O	trace	trace	trace	trace	trace
CO_2	.62	3.99	4.47	18.91	21.82
FeS_2		.08	.24	.49	.22
Fe_7S_8	3.16				
Organic C	.59				
	100.37	100.40	100.28	100.79	99.97

L. Bleached country rock, next to vein, Osborne Hill mine. Derived from sandstone. Analysis by George Steiger, record No. 1541.

M. Altered wall rock, Empire mine. Derived from granodiorite. Analysis by Steiger, No. 1541. Sp. gr., 2.782, 20°.

N. Altered wall rock, Ebaugh tunnel. Derived from granodiorite. Mainly quartz and sericite, with pyrite, apatite, sphene, and carbonates. Analysis by Steiger, No. 1541. Sp. gr., 2.747, 20°.

O. Altered wall rock, Federal Loan mine. Derived from siliceous argillite. Analysis by Steiger, No. 1541.

	L.	M.	N.	O.
SiO_2	71.97	58.43	56.25	34.91
Al_2O_3	15.75	17.40	17.65	15.55
Fe_2O_3	.77	.77	.76	.17
FeO	.45	2.19	2.64	4.96
MgO	.80	1.50	1.69	4.58
CaO	.80	5.25	4.46	11.10
Na_2O	.33	1.76	.30	.19
K_2O	4.88	4.03	6.01	4.28
H_2O at 100°	.30	.30	.30	.30
H_2O above 100°	2.16	2.61	2.36	1.86
TiO_2	.88	none	.25	1.65
P_2O_5	.15	.13	.21	.82
MnO	none	none	none	none
BaO	trace	none	.03	none
SO_3	trace	none	none	none
CO_2	.38	4.04	4.82	15.57
FeS_2	.56	1.59	2.87	4.20
	100.18	100.00	100.60	100.14

7. PLACER COUNTY.

First, a series of rocks from the Ophir mining district, described by Lindgren in 14th Ann., p. 249. Analyses by W. F. Hillebrand, record Nos. 1419, 1433, 1434.

A. Granodiorite, quarries at Lincoln, 8 miles west of Ophir. Contains feldspars, quartz, biotite, and hornblende.

B. Pyritiferous amphibolite, Conrad tunnel. Partly altered. Contains pyrite, hornblende, magnetite, feldspars, quartz, epidote, chlorite, a few scales of mica, rutile, and carbonates. Sp. gr. 2.901, 23°.

C. Dike rock, near camptonite, Casey's tunnel, Flat Ledge, Duncan Hill. Contains hornblende, feldspars, pyrite, and apatite, with secondary epidote and quartz.

D. Altered wall rock, Mina Rica vein. Sp. gr. 2.979, 20°.

E. Altered wall rock, Plantz vein. These rocks, D and E, contain quartz, muscovite, a little chlorite, pyrite, and sphene, with carbonates of calcium, magnesium, and iron.

	A.	B	C.	D.	E.
SiO_2	65.54	45.56	60.09	37.01	46.13
Al_2O_3	16.52	14.15	16.43	12.99	15.82
Fe_2O_3	1.40	1.20	2.28	.43	.89
FeO	2.49	9.83	3.01	3.57	2.27
MgO	2.52	6.76	4.37	5.49	2.13
CaO	4.88	2.30	5.76	9.78	10.68
Na_2O	4.09	1.57	4.52	.13	.17
K_2O	1.95	1.18	.70	4.02	5.30
H_2O at 100°	.12	.23	.20	.13	.12
H_2O above 100°	.59	4.84	1.16	1.92	2.42
TiO_2	.39	1.11	.63	.85	.67
P_2O_5	.18	.14	.12	.06	.10
MnO	.06	.25	.12	.24	.09
Ni, Zn	....	traces	....	traces	traces
SrO	trace	trace	trace	trace	trace
BaO	trace	trace	trace	trace	trace
Li_2O	trace	trace	none	trace	trace
SO_3	....	.03	trace	.04	.04
CO_2	....	3.04	.07	15.04	11.24
FeS_2	....	7.86	.34	7.99	1.61
Cu_2S (?)	....	.10	....	....	....
	100.73	100.15	99.80	99.69	99.68

Second, rocks from other localities in Placer County. Studied also by Lindgren, who furnishes the petrographic data. Analysis A by W. H. Melville, record No. 1346; B, C, D, and E by W. F. Hillebrand, record No. 1419.

A. Granite, Rocklin. A normal granite, containing quartz, orthoclase, plagioclase, biotite, muscovite, magnetite, apatite, and zircon, with some secondary chlorite and epidote derived from the biotite. Described by Lindgren in Bull. 150, p. 170. P. R. C. 66.

B. Granodiorite, Donner Pass. Contains plagioclase, orthoclase, quartz, hornblende, biotite, and sphene.

C. Gabbro, 2 miles south of Emigrant Gap, on road to Onion Valley. Contains biotite, hypersthene, diallage, plagioclase, and orthoclase.

D. Gabbro, same locality as C. Contains hypersthene, diallage, plagioclase, and orthoclase.

E. Augite-granite, southeast spur of English Mountain. Contains "basic" plagioclase, augite, and quartz.

	A.	B.	C.	D.	E.
SiO_2	73.00	59.48	55.40	55.87	64.67
Al_2O_3	16.38	17.25	15.32	13.52	16.62
Fe_2O_3	none	2.15	2.70	2.70	.51
FeO	.99	4.06	5.49	5.89	.76
MgO	.48	2.67	5.75	6.51	2.26
CaO	2.42	6.50	9.90	8.87	9.50
Na_2O	4.53	3.53	2.89	2.42	4.10
K_2O	1.87	2.27	1.52	1.72	.34
H_2O at 100°	.52	.09	.03	.09	.08
H_2O above 100°		.71	.38	1.56	.37
TiO_2	.....	.93	.60	.56	.51
P_2O_5	.....	.33	.22	.25	.12
MnO	.....	.11	.11	.10	trace
SrO	.....	trace	none	none	trace
BaO	.....	.09	.07	.02	.02
Li_2O	.....	trace	trace	trace	trace
	100.19	100.17	100.38	100.08	99.86

8. ELDORADO COUNTY.

A. Granitite, Placerville canal, one-third mile north of Ditch Camp No. 7. Collected by W. Lindgren, who reports it as containing biotite, orthoclase, plagioclase, and quartz. Analysis by George Steiger, record No. 1591.

B. Granodiorite, 2 miles south of Silver Lake Hotel. Collected by Lindgren, who reports it as containing hornblende, biotite, plagioclase, and quartz. Analysis by Steiger, No. 1591. Analyses A and B are published by Lindgren in Amer. Journ. Sci., 4th ser., vol. 3, p. 306.

C. Porphyrite, 1 mile southwest of Latrobe. Published by Turner in 17th Ann., Part I, p. 521. Contains abundant plagioclase, less augite, calcite or dolomite, iron disulphide, a little chlorite, and secondary greenish mica. Analysis by W. F. Hillebrand, record No. 1432. P. R. C. 721.

	A.	B.	C.
SiO_2	77.68	67.45	68.58
Al_2O_3	11.81	15.51	13.04
Fe_2O_3	.72	1.76	.26
FeO	.51	2.21	3.40
MgO	.18	1.10	1.01
CaO	.72	3.60	3.22
Na_2O	2.96	3.47	4.94
K_2O	5.00	3.66	1.90
H_2O at 100°	.04	.14	.16
H_2O above 100°	.27	.63	1.00
TiO_2	.14	.58	.57
P_2O_5	.10	.12	.20
MnO	trace	....	.15
SrO	....	....	trace
BaO	....	....	.10
CO_2	....	....	1.31
FeS_2	....	....	.15
	100.13	100.23	99.99

9. AMADOR COUNTY.

Rocks collected by H. W. Turner, and analyses published in 14th Ann., p. 441, and 17th Ann., Part I, p. 521. Additional data supplied by Turner. Analyses by W. F. Hillebrand, record Nos. 1432, 1456, and 1597.

A. Rhyolite, south point of Buena Vista Peak. Contains sanidine, quartz, and biotite in a glassy groundmass. P. R. C. 729.

B. Quartz-monzonite, north fork of Mokelumne River. Contains plagioclase, microcline, quartz, abundant biotite, iron ore, sphene, apatite, and perhaps rutile. P. R. C. 770.

C. Quartz-monzonite, north fork of the Mokelumne River. Like B. P. R. C. 765.

D. Quartz-porphyrite-schist, 2½ miles southeast of Buena Vista Peak. Contains porphyritic quartz and hornblende, also calcite and other carbonates. See 14th Ann. P. R. C. 723.

E. Quartz-diorite-gneiss, north fork of Mokelumne River. Contains plagioclase, hornblende, quartz, brown mica, accessory biotite, and iron oxide. P. R. C. 764.

F. Diorite-porphyry, north fork of Mokelumne River. Contains plagioclase, brown hornblende, epidote, and a little sulphide of iron and chlorite. P. R. C. 769.

	A.	B.	C.	D.	E.	F.
SiO_2	73.23	70.75	70.43	70.29	57.41	55.18
Al_2O_3	12.73	15.13	15.51	11.83	17.71	17.35
Fe_2O_3	.99	.98	.96	1.30	2.16	2.77
FeO	.16	1.43	1.28	2.08	5.01	3.90
MgO	.22	.73	.37	1.24	3.38	4.80
CaO	.61	3.09	2.76	2.30	6.73	7.98
Na_2O	1.91	3.05	2.75	2.68	3.12	3.42
K_2O	5.17	3.62	5.14	3.05	1.82	1.42
H_2O at 100°	.53	.10	.08	.10	.20	.16
H_2O above 100°	4.51	.51	.40	1.35	1.14	1.52
TiO_2	.09	.42	.24	.29	1.04	.83
P_2O_5	.02	.10	.11	.07	.24	.20
NiO	....	none	(?)	....	.02	.03
MnO	trace	trace	trace	.12	.15	.15
SrO	none	.04	.05	trace?	.04	.06
BaO	.02	.12	.20	.07	.09	.04
Li_2O	trace	trace	trace	none	trace	trace
CO_2	....	none	none	3.25	none	none
FeS_2	....	.06	trace	....	none	.28
	100.19	100.13	100.28	100.02	100.26	100.09

G. Diorite, north fork of Mokelumne River. Contains quartz, feldspar, biotite, sphene, epidote, and secondary chlorite. P. R. C. 771.

H. Diorite, north fork of Mokelumne River. Contains plagioclase. quartz, hornblende, biotite, apatite, iron ore, epidote, and chlorite, P. R. C. 772.

I. Plagioclase-gneiss, north fork of Mokelumne River. Contains plagioclase, hornblende, biotite, and apatite. P. R. C. 768.

J. Plagioclase-gneiss, north fork of Mokelumne River. Contains plagioclase, hornblende, brown mica, apatite, epidote, and grains of iron ore. P. R. C. 767.

	G.	H.	I.	J.
SiO_2	69.66	55.86	52.21	46.63
Al_2O_3	17.57	19.30	18.79	19.47
Fe_2O_3	.21	.91	2.71	3.26
FeO	1.04	4.78	5.30	6.63
MgO	.58	2.94	5.11	5.37
CaO	4.54	7.31	8.01	9.15
Na_2O	4.91	3.52	3.31	3.19
K_2O	.71	1.52	1.60	1.55
H_2O at 110°	.05	.19	.12	.10
H_2O above 110°	.50	1.23	1.35	1.61
TiO_2	.21	1.20	1.16	1.82
P_2O_5	.03	.38	.36	.66
V_2O_3	....	....	....	.02
NiO	none	trace	trace	.02
MnO	trace	.16	.06	.21
SrO	.05	.04	....	.06
BaO	.03	.13	.08	.14
Li_2O	none	trace	trace	trace
CO_2	none	none	none	none
FeS_2	trace?	.39	.06	.19
	100.09	99.86	100.23	100.08

K. Wollastonite-gneiss, north fork of Mokelumne River. Mainly wollastonite, but garnet, quartz, and sphene are also present. P. R. C. 766.

L. Melaphyr-tuff, altered basalt, west of Jackson. Contains augite and plagioclase, with secondary quartz, chlorite, and chrysotile. Originally glassy in part, but devitrified. See 14th Ann. P. R. C. 722.

M. Reddish-brown mica separated from pyroxenic-gneiss, north fork of Mokelumne River, about 1 kilometer above mouth of Bear River. Described by Turner in Amer. Journ. Sci., 4th series, vol. 7. p. 294. Analysis by William Valentine, record No. 1736.

	K.	L.	M.
SiO_2	50.67	49.24	36.62
Al_2O_3	6.37	14.79	14.37
Fe_2O_3	.31	1.36	4.04
FeO	.50	8.00	17.09
MgO	.58	6.89	9.68
CaO	40.34	10.74	1.48
Na_2O	.14	2.76	.45
K_2O	.22	.88	8.20
H_2O at 110°	.08	.20	.90
H_2O above 110°	.31	2.97	3.26
TiO_2	.20	.96	3.03
P_2O_5	none	.17	none
NiO	none	....	....
MnO	trace	.18	.40
SrO	none	trace	trace
BaO	none	.04	.33
Li_2O	none	trace	trace
F	....	....	.10
CO_2	.52	.90	....
	100.24	100.08	99.95
Less O	....	....	.04
			99.91

10. CALAVERAS COUNTY.

Rocks collected by H. W. Turner, and described in 14th Ann., p. 441. Additional data supplied by Turner relative to analysis B. Analyses by W. F. Hillebrand, record No. 1432.

A. Meta-dacite, $1\frac{3}{4}$ miles southeast of Milton. Contains quartz, feldspar, and hornblende. P. R. C. 777.

B. Meta-dacite, $1\frac{1}{2}$ miles northeast of Milton. Contains feldspar, quartz, epidote, chlorite, and iron ore, in a groundmass made up probably of feldspar and quartz. P. R. C. 752.

C. Meta-andesite, $1\frac{1}{2}$ miles northward from Jenny Lind. Contains quartz, plagioclase, epidote, and chlorite derived from augite.

	A.	B.	C.
SiO_2	72.24	71.19	61.37
Al_2O_3	13.84	13.81	15.41
Fe_2O_3	1.45	1.45	3.15
FeO	1.86	1.68	3.89
MgO	1.10	.74	3.48
CaO	3.40	2.87	4.42
Na_2O	4.43	4.24	3.76
K_2O	.39	1.82	.34
H_2O at 100°	.17	.15	.29
H_2O above 100°	.69	.92	2.70
TiO_2	.41	.35	.60
P_2O_5	.10	.08	.08
MnO	.12	.07	.47
SrO	trace	trace	trace
BaO	.08	.16	.08
CO_2	....	.82	....
	100.28	100.35	100.04

11. TUOLUMNE COUNTY.

Rocks collected by H. W. Turner, and partly described in his papers in the 14th and 17th Annuals. The latites were named and described by Ransome in Bull. 89. Some additional data have been furnished by Turner.

A. Soda-syenite-porphyry, dike east of Moccasin Creek. Consists mainly of albite, with a greenish mineral which is probably ægirite. Analysis by H. N. Stokes, record No. 1563. P. R. C. 773.

B. Augite-syenite, dike on Turnback Creek, about 1 mile north of Carter post-office. Hitherto unpublished. Contains orthoclase and augite, with less plagioclase and quartz. Analysis by Stokes, No. 1642.

C. Diorite, dike 1½ miles southeasterly from Sonora. Contains feldspar largely altered to hornblende. A few black grains are probably iron ore. Analysis by W. F. Hillebrand, record No. 1548. P. R. C. 759.

D. Quartz-pyroxene-diorite, large area east of Sonora. Contains plagioclase, quartz, biotite, augite, rhombic pyroxene, and a trace of iron ore. Analysis by Hillebrand, No. 1548. P. R. C. 760.

E. Diorite, dike about 1½ miles southeasterly from Sonora. Contains altered plagioclase and hornblende, with epidote, chlorite, and iron disulphide as secondary products. Analysis by Hillebrand, No. 1548. P. R. C. 761.

	A.	B.	C.	D.	E.
SiO_2	67.53	61.28	58.05	57.80	53.46
Al_2O_3	18.57	14.71	15.46	16.43	14.81
Fe_2O_3	1.13	1.21	1.69	1.62	2.60
FeO	.08	2.85	5.09	6.51	5.15
MgO	.24	1.69	4.84	4.14	7.27
CaO	.55	5.61	6.94	7.21	8.44
Na_2O	11.50	2.99	2.86	2.35	2.64
K_2O	.10	7.70	2.14	2.29	1.30
H_2O at 110°	.15	.28	.10	.11	.12
H_2O above 110°	.31	.43	2.02	.38	2.13
TiO_2	.07	.41	.72	.70	.70
P_2O_5	.11	.16	.16	.19	.16
MnO	trace	trace	.14	.18	.18
NiO			none	.03	.05
SrO	trace	.04	trace	trace?	trace
BaO		.72	.07	.09	.05
Li_2O			trace	trace	trace
SO_3	trace	.08			
CO_2			none	none	.44
F	trace				
FeS_2			none	none	.26
	100.34	100.16	100.28	100.03	99.76

F. Biotite-augite-latite, 4 miles southwest of Clover Meadow. Called "trachyte-andesite-tuff" in former edition of this bulletin. Contains plagioclase, biotite, augite, magnetite, apatite, and glass. Analysis by W. F. Hillebrand, record No. 1597. P. R. C. 762.

G. Augite-latite, Dardanelle flow, near Clover Meadow. Called "trachyte-andesite" in former edition. Contains plagioclase, in part labradorite, augite, iron ore, some olivine, apatite, and brown glass. The potassium is probably in the glass, as no potash mineral was observed. Analysis by H. N. Stokes, record No. 1645. P. R. C. 785.

H. Augite-latite, Table Mountain. Called "basalt" in former edition. Contains labradorite, olivine, augite, and magnetite. Analysis by Hillebrand, record No. 1273. P. R. C. 724.

I. Augite-latite, Table Mountain, near Clover Meadow. Contains labradorite, augite, olivine, magnetite, apatite, and glass. Analysis by George Steiger, record No. 1697.

	F.	G.	H.	I.
SiO_2	62.33	59.43	56.19	56.78
Al_2O_3	17.30	16.68	16.76	16.86
Fe_2O_3	3.00	2.54	3.05	3.56
FeO	1.63	3.48	4.18	2.93
MgO	1.05	1.84	3.79	3.41
CaO	3.23	4.09	6.53	6.57
Na_2O	4.21	3.72	2.53	3.19
K_2O	4.46	5.04	4.46	3.48
H_2O at 110°	.44	.27	.34	.15
H_2O above 110°	.75	.72	.66	1.21
TiO_2	1.05	1.38	.69	1.15
P_2O_5	.29	.58	.55	.42
ZrO_2	.04	.08		
V_2O_3	.01			
MnO	.08	trace	.10	none
SrO	.05	trace	trace	
BaO	.24	.14	.19	trace
Li_2O	trace	none	trace	
CO_2				.18
Cl		.05		
F		trace		
C	.11			
FeS_2	.06			
	100.33	100.04	100.02	99.89

J. Amphibole-gabbro, Beaver Creek, Big Trees quadrangle. Contains labradorite and amphibole, with a little pyrite and pyrrhotite. Analysis by H. N. Stokes, record No. 1752.

K. Amphibole separated from J. Analysis by William Valentine, record No. 1733.

L. Olivine-gabbro, just east of south end of Phœnix reservoir. Contains plagioclase, a few grains of alkali feldspar, augite, rhombic pyroxene, amphibole, olivine, magnetite, and iron sulphide, with a little secondary chlorite and epidote. Analysis by H. N. Stokes, record No. 1750.

For description of J and K see Turner, Amer. Jour. Sci., 4th series, vol. 7. p. 294. The description of L is hitherto unpublished.

	J.	K.	L.
SiO_2	47.27	46.08	43.41
Al_2O_3	20.82	10.52	23.15
Fe_2O_3	1.85	2.81	3.72
FeO	4.26	8.30	4.39
MgO	6.44	14.40	7.65
CaO	13.02	12.64	14.27
Na_2O	2.75	1.62	.82
K_2O	.22	.34	.22
H_2O at 110°	.08	.17	.18
H_2O above 110°	1.27	1.97	1.53
TiO_2	.92	.77	.39
P_2O_5	.74	.18	.02
V_2O_3	.02	.04	....
Cr_2O_3	trace	....	none
MnO	trace	.15	.08
SrO	trace	....	....
Li_2O	none	none	trace
CO_2	....	....	.10
FeS_2	.20	....	.14
Cl	trace	....	trace
	99.86	99.99	100.07

12. MARIPOSA COUNTY.

Rocks collected by H. W. Turner, and partly described in his papers n the 14th and 17th Annuals. Additional data supplied by Turner.

A. Soda-granulite or aplite, about 4 miles west of Mariposa. See 7th Ann., Part I, p. 721. Contains plagioclase (albite?) and micro-egmatite, with less epidote, quartz, sphene, and apatite. Analyses y W. F. Hillebrand, record No. 1461. P. R. C. 748.

B. Micropegmatite, Agua Fria Creek. See 17th Ann., Part I, p. 91. Contains quartz, plagioclase, brown mica, epidote, and a little on ore. Analysis by Hillebrand, No. 1461. P. R. C. 746.

C. Soda-granite-porphyry, Merced River, below the mouth of the orth fork. Published in 17th Ann. Contains feldspar, largely albite, ornblende, muscovite, abundant epidote, apatite, and a little iron ore. nalysis by George Steiger, record No. 1573. P. R. C. 774.

D. Granite-porphyry, about one-fourth of a mile north of Lake enaya, Yosemite National Park. See 14th and 17th Annuals. Con-ins orthoclase, quartz, plagioclase, and biotite, with a little iron ore d sphene. Analysis by Hillebrand, record No. 1432. P. R. C. 726.

E. Granite, west of Lake Tenaya, Yosemite National Park. See th and 17th Annuals. Contains quartz, orthoclase, plagioclase, and otite, with some hornblende, iron ore, sphene, and apatite. Analysis Hillebrand, No. 1432. P. R. C. 725.

	A.	B.	C.	D.	E.
SiO_2	74.21	73.18	71.88	72.48	66.28
Al_2O_3	14.47	13.66	15.57	14.06	16.03
Fe_2O_3	.35	.21	1.07	.89	1.80
FeO	.50	2.24	.30	1.05	1.88
MgO	.28	.93	.68	.62	1.12
CaO	1.71	2.10	2.03	2.17	3.75
Na_2O	7.62	3.70	5.81	3.30	4.10
K_2O	.10	2.72	1.80	4.75	3.49
H_2O at 110°	.15	.10	.11	.16	.10
H_2O above 110°	.23	.57	.68	.35	.39
TiO_2	.30	.25	.17	.28	.54
P_2O_5	.07	.09	.08	.09	.30
MnO	none	.07	none	trace	.05
SrO	trace	trace	.08	trace	trace
BaO	none	.10	.02	.08	.08
Li_2O	trace	trace	none	trace	trace
CO_2	....	.17	none	....	....
	99.99	100.09	100.28	100.28	99.91

F. Amphibole-biotite granite, Nevada Falls trail, Yosemite Valley. Contains alkali feldspar, plagioclase, quartz, amphibole, biotite, magnetite, and apatite.

G. Biotite-granite, base of El Capitan, Yosemite Valley. Contains alkali feldspar, plagioclase, quartz, biotite, titanite, apatite, and iron oxides.

H. Brown mica separated from G.

Analyses F, G, and H by William Valentine, record Nos. 1732, 1733.

I. Amphibole separated from quartz-monzonite, Tioga road, southeast of Mount Hoffman. Sp. gr. 3.203, 2.15°.

J. Mica separated from the same rock as I. Sp. gr. 3.05, 21°.

Analyses I and J by W. F. Hillebrand, record No. 1774.

Samples G to J are described by Turner in Amer. Journ. Sci., 4th series, vol. 7, p. 294.

	F.	G.	H.	I.	J.
SiO_2	66.83	71.08	35.64	47.49	35.75
Al_2O_3	15.24	15.90	18.62	7.07	14.70
Fe_2O_3	2.73	.62	5.54	4.88	4.65
FeO	1.66	1.31	14.60	10.69	14.08
MgO	1.63	.54	9.72	13.06	12.37
CaO	3.59	2.60	.90	11.92	.17
Na_2O	3.10	3.54	.38	.75	.32
K_2O	4.46	4.08	9.22	.49	9.19
H_2O at 110°	none	none	.48	......	1.03
H_2O above 110°	.56	.30	2.54	1.86	3.64
TiO_2	.54	.22	1.12	1.21	3.16
P_2O_5	.18	.10	.20	none	.03
ZrO_2	.04	.08	......	......	......
V_2O_3	......	......	......	.04	.05
Cr_2O_3	......	......	......	none	trace
MnO	.10	.15	.79	.51	.45
NiO, CoO	......	......	......	.02	.02
SrO	.03	.02	......	none	(?)
BaO	.11	.04	trace	none	.12
Li_2O	trace	trace	trace	trace	......
CO_2	trace	trace	......	......	......
Cl	.02	.02	......	......	......
F	......	......	.26	.06	.17
	100.82	100.60	100.01	100.05	99.90
Less O	......	......	.11	.02	.07
			99.90	100.03	99.83

K. Quartz-mica-diorite, Chowchilla River. See 17th Ann., Part I, p. 691. Contains plagioclase, quartz, a little orthoclase (?), brown mica, hornblende, rather abundant apatite, a little iron ore; one zircon-like crystal was noted. Analysis by W. F. Hillebrand, record No. 1461. P. R. C. 745.

L. Quartz-mica-diorite, Yaqui Creek. For the Educational Series of Rocks. Contains plagioclase, quartz, biotite, hornblende, a little pyroxene, iron ore, and apatite. Analysis by George Steiger, record No. 1643. P. R. C. 135. Described by Turner in Bull. 150, p. 339.

M. Diabase, dike 1½ miles northeast of Hornitos. See 17th Ann., Part I, p. 694. Contains plagioclase, partly labradorite, augite, brown hornblende, and iron ore. Analysis by Hillebrand, No. 1461. P. R. C. 750.

N. Igneous rock, near Cathay Hill. See 17th Ann., Part I, p. 694. Contains two minerals unidentified; neither is olivine. Analysis by Hillebrand, No. 1461. P. R. C. 749.

	K.	L.	M.	N.
SiO_2	62.62	58.09	51.32	47.75
Al_2O_3	17.51	17.46	15.28	10.56
Fe_2O_3	.49	1.12	.47	.74
FeO	4.06	5.08	8.59	8.34
MgO	2.84	4.06	7.25	19.09
CaO	5.49	6.24	11.58	9.62
Na_2O	3.49	2.94	2.92	1.32
K_2O	1.76	2.02	.22	.12
H_2O at 110°	.22	.29	.06	.05
H_2O above 110°	.92	1.45	.95	2.06
TiO_2	.55	.95	1.23	.37
P_2O_5	.12	.17	.25	.03
Cr_2O_3				.24
NiO				.07
MnO	.05	none	.16	.10
SrO	trace	.04	trace	trace
BaO	trace	.07	none	none
Li_2O	trace	none	trace	trace
CO_2		.21		
SO_3		.05		
Cl		.02		
F		trace		
C		.11		
	100.12	100.37	100.28	100.46

O. Feldspathic mica-schist, Chowchilla River. See 17th Ann., Part I, p. 691. Contains quartz, feldspar, biotite, muscovite, apatite, and specular iron. Analysis by W. F. Hillebrand, record No. 1461. P. R. C. 744.

P. Andalusite-hornfels, Yaqui Gulch. Principally quartz, andalusite, brown and white mica, black graphite-like grains, a little iron ore, and probably feldspar. Analysis by George Steiger, record No. 1643. Described by Turner in Bull. 150, p. 342. P. R. C. 135.

Q. Andalusite-schist, Chowchilla River. See 17th Ann., Part I, p. 691. Contains quartz, biotite, andalusite, sericite, a little muscovite, probably graphite, iron ore, a few garnets, and apparently chlorite. Analysis by Hillebrand, No. 1461. P. R. C. 743.

R. Chiastolite-schist, Yaqui Gulch. Contains chiastolite, sillimanite, brown mica, sericite (?), probably graphite, and clear grains which appear to be quartz and feldspar. Analysis by Steiger, No. 1643. Described by Turner in Bull. 150, p. 342. P. R. C. 135.

S. Hornfels, Agua Fria Creek. See 17th Ann., Part I, p. 691. Contains quartz, brown mica, iron ore, and plagioclase. Analysis by Hillebrand, No. 1461. P. R. C. 747.

	O.	P.	Q.	R.	S.
SiO_2	70.40	65.10	64.28	62.15	68.27
Al_2O_3	14.70	17.77	17.28	19.34	14.03
Fe_2O_3	.65	1.95	1.10	4.23	.46
FeO	2.57	3.29	5.34	2.25	4.68
MgO	1.47	1.43	2.57	1.88	2.23
CaO	1.63	1.38	1.19	1.50	3.89
Na_2O	3.17	2.25	.91	1.60	2.29
K_2O	3.46	2.45	2.93	3.07	3.35
H_2O at 110°	.19	.47	.20	.19	.08
H_2O above 110°	.91	2.49	2.72	1.79	.98
TiO_2	.51	.72	.65	.80	.57
P_2O_5	.05	.14	.27	.15	.21
MnO	.08	none	.09	trace	.04
SrO	trace	none	trace	none	trace
BaO	.09	none	.10	.04	.08
Li_2O	trace	none	trace	none	trace
SO_3	....	.03	....	.13	....
Cl	....	trace	....	none	....
F	....	.12	....	.22	....
C	.15	1.21	.43	1.12	....
	100.03	100.80	100.06	100.55	100.16
Less O	....	.06	....	.10	....
		100.74	....	100.45	

13. THE QUICKSILVER REGION.

Rocks described by Becker in Mon. XIII. Analyses made by W. H. Melville in the San Francisco laboratory. With one exception (the serpentine from New Idria) all the rocks are from the districts north of San Francisco.

A. Pseudo-diabase, near Mount St. Helena. Contains augite, hornblende, oligoclase, albite, zoisite, ilmenite, leucoxene, and a little chlorite.

B. Pseudo-diabase, Sulphur Bank. Contains oligoclase, a little quartz, pyroxene, hornblende, ilmenite, sphene, serpentine, and chlorite.

C. Pseudo-diorite, Knoxville. Mainly actinolite, with a little white mica, chlorite, serpentine, sphene, rutile, and zircon.

D. Glaucophane-schist, Sulphur Bank. Mainly glaucophane and zoisite. Quartz, albite, muscovite, and sphene are also present.

	A.	B.	C.	D.
SiO_2	49.08	51.28	50.44	49.68
Al_2O_3	14.68	15.05	8.18	13.60
Fe_2O_3	1.95	2.42	1.06	1.86
FeO	9.63	8.01	6.29	8.61
MgO	6.69	6.07	17.63	6.26
CaO	10.09	7.08	11.55	10.97
Na_2O	4.60	4.43	2.98	3.09
K_2O	.20	.12	.50	.12
H_2O at 100°	.27	.39	.07	----------
H_2O above 100°	1.18	2.96	.92	3.84
TiO_2	1.72	1.33	----------	1.31
P_2O_5	.23	.13	----------	.21
Cr_2O_3	----------	----------	.48	----------
MnO	.15	.25	.21	.04
NiO	----------	.10	----------	----------
	100.47	99.62	100.31	99.59

E. Andesitic obsidian, Clear Lake. Shows grains of plagioclase, augite, and hypersthene. Sp. gr. 2.391.

F. Andesite (asperite), Clear Lake. Contains pyroxene, plagioclase, magnetite, and sometimes biotite. Pyroxene mostly rhombic. Sp. gr. 2.664.

G. Obsidian, south of Borax Lake. Sp. gr. 2.390.

H. Basalt, south of Burns Valley. Rich in olivine, with a microlitic groundmass of plagioclase and augite. Sp. gr. 2.380.

I. Ordinary basalt, Knoxville.

	E.	F.	G.	H.	I.
SiO_2	74.01	65.43	75.40	57.37	51.66
Al_2O_3	12.95	17.10	7.72	15.66	11.22
Fe_2O_3		2.39	1.41	2.06	7.62
FeO	1.42	1.19		4.46	
MgO	.48	1.48	1.26	8.84	13.61
CaO	.99	3.88	1.55	4.94	7.72
Na_2O	5.34	3.66	8.09	3.05	5.98
K_2O	4.65	2.83	4.52	1.51	.89
H_2O at 100°		.20	.43	.61	1.06
H_2O above 100°	.29	.36		.12	
TiO_2	.24	.83		.60	trace
P_2O_5	.01	trace		.02	
Cr_2O_3					.25
MnO	trace	.70	.12	.27	.12
NiO		.20		.41	
Cl	.07		.12		
	100.45	100.25	100.62	99.92	100.13

J. Light-green, marmolitic serpentine, New Idria.

K. Black serpentine, Sulphur Bank.

L. Light-green serpentine, Sulphur Bank.

	J.	K.	L.
SiO_2	41.54	39.64	41.86
Al_2O_3	2.48	1.30	.69
FeO	1.37	7.76	4.15
MgO	40.42	37.13	38.63
H_2O	14.18	13.81	14.16
Cr_2O_3		.29	.24
MnO		.12	.20
NiO	.04	.33	trace
	100.03	100.38	99.93

14. MOUNT DIABLO.

Described by Turner and Melville in Bull. Geol. Soc. Amer., vol. 2, pp. 383–414. Analyses by W. H. Melville. Those with record numbers were made in the Washington laboratory; the others were made in the laboratory at San Francisco.

A. Diabase, Mitchell Canyon. Composed of augite, plagioclase, and ilmenite, with uralite and chlorite secondary.

B. The same rock, partly altered and partly uralitic. Called "diabase-diorite" by Turner.

C. Pyroxenite, near Bagley Creek. Composed of bronzite and diallage. Equivalent to the websterite of North Carolina. P. R. C., 735.

D. Glaucophane-schist, Pine Canyon. Contains numerous cinnamon garnets.

A, B, and C have the record No. 1247.

	A.	B.	C.	D.
SiO_2	52.06	51.58	53.25	47.84
Al_2O_3	14.34	14.99	2.80	16.88
Fe_2O_3	2.11	2.04	.69	4.99
FeO	7.74	8.36	5.93	5.56
MgO	9.26	6.51	19.91	7.89
CaO	8.05	8.59	16.22	11.15
Na_2O	1.74	3.08	.19	3.20
K_2O	.73	.31	trace	.46
H_2O at 105°	.59	.34	.05	.17
H_2O above 105°	2.90	2.67	.24	1.81
TiO_2	.47	1.05		
P_2O_5	.13	.24		.14
Cr_2O_3			.54	
NiO			.07	
MnO	trace	trace	.09	.56
	100.12	99.76	99.98	100.65

E. Crystalline gabbro, Bagley Creek. Contains plagioclase and diallage. Record No. 1166.

F. Shaly gabbro. Friable, containing carbonates and sulphates. Somewhat resembles serpentine.

G. Shaly gabbro, like F, much resembling a true serpentine.

According to Turner, F and G are merely weathered layers of the gabbro.

	E.	F.	G.
SiO_2	47.49	45.43	45.69
Al_2O_3	15.81	12.55	13.30
Fe_2O_3	1.07	....	1.85
FeO	4.50	6.50	4.72
MgO	10.39	13.41	13.06
CaO	15.53	12.39	13.50
Na_2O	1.16	1.71	1.36
K_2O	trace	.11	trace
H_2O at 105°	1.20	2.41	2.29
H_2O above 105°	1.83	2.74	2.47
P_2O_5	trace	.04	.06
NiO	.06	....	....
MnO	.41	.21	.24
CO_2	....	2.35	1.89
SO_3	....	.24	.43
Organic matter	....	trace	....
	99.45	100.09	100.86

The following analyses are of serpentines derived from a peridotite-pyroxenite dike:

H. Almost black. Possibly derived from adjacent shale.
I. Almost black. Derived from pyroxenite.
J. Bastite. Derived from pyroxenite. Record No. 1166.
K. Friable serpentine.

	H.	I.	J.	K.
SiO_2	38.53	40.50	36.57	36.96
Al_2O_3	14.55	.78	.95	.39
Fe_2O_3	2.65	4.01	7.29	5.00
FeO	4.01	2.04	.37	2.34
MgO	21.79	37.43	40.27	33.84
CaO	3.13	.39	.14	3.81
Na_2O	.07	.28	.31	.34
K_2O	.88	.16	trace	.14
H_2O at 100°	4.51	2.81	.94	2.16
H_2O above 100°	9.56	10.94	12.43	14.02
P_2O_5	trace	trace	....	.02
Cr_2O_3	trace	.41	.33	.78
NiO	trace	.11	.31	trace
MnO	.32	.13	.10	.09
	100.00	99.99	100.01	99.89

Accidental organic matter was deducted from analyses H and I, with subsequent recalculation of the data to 100 per cent.

L. Serpentine.
M. Talc-like, yellowish-green serpentine.
N. Weathered serpentine.
O. Olive colored, probably serpentine.

Samples H, I, and J are from near Bagley Creek; K, L, M, and N from near Arroyo del Cerro; O from Ferguson ravine. M and O carry considerable chromite.

	L.	M.	N.	O.
SiO_2	34.84	32.27	41.52	30.98
Al_2O_3	.42	11.45	1.57	1.04
Fe_2O_3	6.08	trace	3.50	4.88
FeO	1.85	5.05	1.07	2.01
MgO	30.74	33.30	36.84	38.44
CaO	7.02	.41	.44	.22
Na_2O	.42	trace	....	.40
K_2O	.07	trace	....	.16
H_2O at 100°	1.67	.44	3.32	.39
H_2O above 100°	15.72	12.40	12.51	20.43
P_2O_5	.04	trace	....	trace
Cr_2O_3	.68	5.19	....	.34
NiO	trace	.19	....	....
MnO	.01	trace	.29	.42
SO_3	....	....	....	.44
	99.56	100.70	101.06	100.15

15. MISCELLANEOUS ROCKS.

A. Rhyolitic obsidian, Medicine Lake, Modoc County. Collected by J. S. Diller, who reports it to be a banded obsidian, containing a few minute feldspar crystals. The banding is due to a multitude of trichites. Analysis by L. G. Eakins, record No. 1072.

B. Tuff from Hyampom, south fork of Trinity River, Trinity County. Almost wholly made up of particles of clear glass. Collected and described by Diller. Analysis by George Steiger, record No. 1427.

C. Diabase-porphyrite, one-half mile west of Browns Valley, Yuba County. Collected and described by W. Lindgren. Contains augite, plagioclase, magnetite, chlorite, and epidote. Analysis by W. F. Hillebrand, record No. 1419.

D. Amphibolitic schist, 1 mile northeast of Browns Valley, Yuba County. Collected and described by W. Lindgren. From metamorphosis of C. Contains chiefly green hornblende and feldspar. Analysis by Hillebrand, No. 1419.

	A.	B.	C.	D.
SiO_2	73.51	70.40	48.26	54.13
Al_2O_3	14.42	13.50	14.83	14.53
Fe_2O_3	.46	1.31	3.27	1.50
FeO	1.49	1.61	5.97	5.25
MgO	.33	.37	8.77	10.93
CaO	1.26	.56	11.38	4.91
Na_2O	4.03	2.11	1.57	3.53
K_2O	4.29	2.39	1.13	.32
H_2O at 100°	.40	1.05	.10	.20
H_2O above 100°		7.41	3.37	4.01
TiO_2			.51	.46
P_2O_5	.04	.08	.25	.09
MnO	trace	trace	.15	.15
SrO			trace	trace
BaO			.05	.02
Li_2O			trace	none
CO_2			1.24	
	100.23	100.79	100.85	100.03

E. Basalt, base of a lava flow, east of the head of the San Joaquin River, Madera County. Description supplied by Turner. Hitherto unpublished. Contains pyroxene, partly augite, plagioclase, olivine, and iron ores. Analysis by W. F. Hillebrand, record No. 1767.

F. Olivine-basalt, west peak of the Dardanelles, Alpine County. Described by Ransome in Bull. 89. Contains olivine, largely altered to iddingsite, plagioclase, serpentine, and augite. Analysis by George Steiger, record No. 1697.

G. Mica separated from quartz-monzonite, near Bloods Station, Alpine County. Described by Turner in Amer. Journ. Sci., 4th series, vol. 7, p. 294. Analysis by William Valentine, record No. 1736.

	E.	F.	G.
SiO_2	51.89	48.76	35.62
Al_2O_3	15.28	16.60	15.24
Fe_2O_3	3.10	5.60	4.69
FeO	3.60	5.01	13.67
MgO	8.68	6.93	12.70
CaO	7.38	8.79	.95
Na_2O	3.27	2.47	.50
K_2O	2.57	.66	7.72
H_2O, at 105°	1.17	1.49	.94
H_2O, above 105°	1.37	2.19	4.36
TiO_2	.91	1.26	2.61
P_2O_5	.61	.19	....
ZrO_2	trace	....	....
MnO	.12	none	....
NiO	.02	....	....
SrO	.09	....	trace
BaO	.15	trace	.26
Li_2O	trace	....	trace
CO_2	none	.42	....
	100.21	100.37	100.00

H. Scoriaceous rhyolite, Mono Craters, south of Mono Lake. Described by Russell in 8th Ann., Part I, p. 380. Analysis by T. M. Chatard, record No. 36.

I. Obsidian, Mono Lake. Analysis by W. H. Melville, record No. 1346. Described by Lindgren in Bull. 150, p. 149. P. R. C. 60.

J. Pumice, Mono Lake. Analysis by Melville, No. 1346. Described by Lindgren in Bull. 150, p. 148. P. R. C. 59.

K. Volcanic ash, east shore of Owens Lake. Collected and analyzed by Chatard, record No. 783.

	H.	I.	J.	K.
SiO_2	74.05	75.78	67.39	55.81
Al_2O_3	13.85	12.39	15.99	10.07
Fe_2O_3	trace	.22	.56	3.43
FeO		1.25	1.99	.67
MgO	.07	.31	.77	2.22
CaO	.90	.81	1.63	1.05
Na_2O	4.60	4.00	4.74	.75
K_2O	4.31	4.64	4.80	2.98
H_2O at 110°	2.20	.41	2.06	.65
H_2O above 110°				2.50
TiO_2				.80
P_2O_5				.27
MnO				.23
$CaCO_3$				14.44
NaCl, soluble				1.45
Na_2SO_4, soluble				.80
Na_2CO_3, soluble				2.09
	99.98	99.81	99.93	100.21

OREGON.

1. BASALT, MOUNT THIELSEN.

Partly described by Diller in Am. Journ. Sci., 3d series, vol. 28, p. 257. A hypersthene-basalt containing hypersthene, olivine, feldspar, and magnetite. In the printed paper only the analyses of the groundmass and the fulgurite formed in it are given.

A. Hypersthene-basalt.
B. Pyroxene.
C, D. Feldspars.
E. Groundmass.
F. A fulgurite, or lightning tube.

Analyses A and F by F. W. Clarke, record Nos. 108, 105; B, C, D, and E by T. M. Chatard, record Nos. 135, 133, 134, 128. These analyses were made early in the history of the laboratory and are by no means complete.

	A.	B.	C.	D.	E.	F.
SiO_2	55.68	53.31	55.48	51.95	55.85	55.04
Al_2O_3	18.93	5.99	26.91	28.84	22.95	28.99 (Al_2O_3, Fe_2O_3, FeO)
Fe_2O_3	8.73 (Fe_2O_3, FeO)	13.43 (Fe_2O_3, FeO)	2.32 (Fe_2O_3, FeO)	2.24 (Fe_2O_3, FeO)	4.59 (Fe_2O_3, FeO)	
FeO						
MgO	4.86	21.69	2.27	1.34	3.08	5.85
CaO	7.99	3.69	8.11	11.42	8.41	7.86
Na_2O	2.12	....	3.14	3.22	2.16	....
K_2O	.48	....	.72	.59	2.67	....
H_2O	.60	....	.66	.40	.52	1.11
TiO_2	....	....	.39	trace	....	....
P_2O_5	....	....	....	....	trace	....
	99.39	98.11	100.00	100.00	100.23	98.85

Iron oxides not separated. Analyses B, C, D, and F made on very small quantities of material. C and D were analyzed by the hydrofluoric acid method, and the silica was determined by difference.

2. PERIDOTITE, DOUGLAS COUNTY.

The matrix of the nickel silicate at Riddle. Described by Diller and Clarke in Bull. 60, p. 21.

The rock, which may be classed as saxonite, consists essentially of olivine and enstatite, with a little chromite and magnetite. Olivine predominates, and the enstatite forms less than one-third of the mass. Quartz, serpentine, and genthite are present as alteration products. Analyses by F. W. Clarke, record Nos. 811, 814, 792.

A. The fresh rock. P. R. C. 114.

B. Separated olivine.

C. The genthite found in the altered rock. Probably derived from olivine.

	A.	B.	C.
SiO_2	41.43	42.81	44.73
Al_2O_3	.04	....	} 1.18
Fe_2O_3	2.52	2.61	
FeO	6.25	7.20	....
MgO	43.74	45.12	10.56
CaO	.55	none	....
H_2O at 110°	....	....	8.87
H_2O ign	4.41	.57	6.99
Cr_2O_3	.76	.79	....
MnO	none	none	....
NiO	.10	.26	27.57
	99.80	99.36	99.90

3. CRATER LAKE.

Rocks collected by J. S. Diller. Petrographic data, hitherto unpublished, supplied by Horace B. Patton for all except the last rock in the series. Analyses A to J, inclusive, by H. N. Stokes, record No. 1671.

A. Vitrophyric rhyolite, south edge of Llao Rock flow. Contains plagioclase, hypersthene, hornblende, and apatite in a glassy groundmass crowded with augite microlites.

B. Streaked rhyolite, near "Wine Glass" Grotto Cove. Contains plagioclase, hypersthene, hornblende, and magnetite, with black glass. A few small inclusions of basalt and hypersthene-andesite.

C. Rhyolite, small dike immediately below Llao Rock. Contains plagioclase, hornblende, hypersthene, and magnetite, in a glassy groundmass crowded with microlites of feldspar and augite.

D. Rhyolite, water's edge, head of Cleetwood Cove. Contains plagioclase, hypersthene, brown hornblende, and magnetite, in a feldspathic groundmass of trachytic type.

E. Hypersthene-augite-andesite, large dike transsecting the northwestern portion of the crater rim. Contains plagioclase, hypersthene, augite, and magnetite in a groundmass having a moderate amount of glass.

F. Hypersthene-augite-andesite, west edge of Wizard Island. Same minerals as E.

	A.	B.	C.	D.	E.	F.
SiO_2	70.77	68.17	71.87	70.10	60.09	59.39
Al_2O_3	14.83	15.60	14.53	15.18	17.85	18.45
Fe_2O_3	1.35	2.31	1.28	1.78	2.03	1.79
FeO	1.25	.94	1.02	1.09	3.45	3.90
MgO	.64	1.02	.48	.74	3.50	3.13
CaO	2.12	2.76	1.59	2.27	6.28	6.29
Na_2O	5.07	5.15	5.08	5.15	4.17	4.29
K_2O	2.68	2.46	2.84	2.58	1.31	1.29
H_2O at 110°	.07	.09	.06	.10	.12	.10
H_2O above 110°	.33	.45	.22	.19	.26	.42
TiO_2	.38	.54	.41	.48	.54	.41
P_2O_5	.13	.13	.10	.13	.23	.22
ZrO_2	.05	none	.04	.04	none	none
NiO	none	none	none	none	.05	none
SrO	.02	.03	.03	.03	.05	.04
BaO	.08	.06	.08	.08	.05	.05
Li_2O	trace	trace	trace	trace	trace	trace
Cl	.11	trace	trace	.03	trace	trace
	99.88	99.71	99.63	99.97	99.98	99.77

Traces of manganese in all. Fluorine not sought for. No CO_2, S, SO_3, or Cr_2O_3 in any.

G. Hypersthene-augite-andesite, crater rim, just south of "The Watchman." Same minerals as F.

H. Hypersthene-augite-andesite, Palisades, under Round Top, northeast portion of the rim. Contains plagioclase, hypersthene, augite, and magnetite.

I. Hypersthene-augite-andesite, lake level, under Llao Rock. Same minerals as H.

J. Basalt, base of Red Cone. Contains plagioclase, augite, olivine, and magnetite, with some glass base.

K. Basalt, one mile east of the summit of the Cascade Range, on the road from Fort Klamath to Crater Lake. Described by J. S. Diller as a typical basalt, carrying a considerable amount of hypersthene. Analysis by W. F. Hillebrand, record No. 408.

	G.	H.	I.	J.	K.
SiO_2	60.98	62.09	58.41	52.99	57.47
Al_2O_3	17.82	17.03	17.85	16.71	18.86
Fe_2O_3	1.83	2.38	2.67	3.80	2.21
FeO	3.33	2.69	3.29	3.55	4.08
MgO	2.76	3.08	3.61	6.95	4.27
CaO	5.73	5.65	6.81	8.49	7.42
Na_2O	4.26	4.10	3.77	3.56	3.85
K_2O	1.43	1.67	1.23	1.29	.73
H_2O at 110°	.13	.04	.34	.18	} .22
H_2O above 110°	.45	.13	.86	.59	
TiO_2	.71	.65	.69	1.18	.75
P_2O_5	.17	.19	.24	.42	.24
NiO	none	none	none	.02	----------
MnO	trace	trace	trace	trace	.10
SrO	.05	.07	.05	.12	.11
BaO	.06	.07	.05	.07	.03
Li_2O	none	none	trace	none	----------
Cl	trace	trace?	trace	trace	----------
	99.71	99.84	99.87	99.92	100.34

4. ROCK FROM WILBUR, DOUGLAS COUNTY.

A tuff partly of igneous, partly of organic, origin. The igneous matter contains a few grains of feldspar and augite, with particles of a rock like diabase. The organic remains are partly calcareous and partly siliceous. Description supplied by J. S. Diller. Analysis by H. N. Stokes, record No. 1737.

SiO_2	55.15
Al_2O_3 *a*	9.75
Fe_2O_3	7.76
MgO	2.22
CaO	10.48
Na_2O	1.00
K_2O	.50
H_2O at 110°	2.70
H_2O above 110°	6.59
CO_2	3.64
	99.79

a Includes TiO_2 and P_2O_5 if present.

WASHINGTON.

Rocks from the Mount Stuart quadrangle, Kittitas County. Collected by George Otis Smith, who furnishes the petrographic data. Hitherto unpublished. Analyses A, B, C, F, and G by H. N. Stokes, record No. 1836; D, E, H, and I by W. F. Hillebrand, record No. 1831.

A. Granodiorite, south slope of Mount Stuart. Contains plagioclase, orthoclase, hornblende, biotite, quartz, and magnetite.

B. Granodiorite, ridge between Hardscrabble and Cascade creeks. Contains plagioclase, orthoclase, biotite, hornblende, quartz, magnetite, and apatite.

C. Granodiorite-porphyry, dike 2 miles west of Mount Stuart. Contains plagioclase, biotite, hornblende, orthoclase, and quartz.

D. Serpentine, Three Brothers. Derived from saxonite. Contains serpentine, bastite, magnetite, and pyrite.

E. Metamorphic rock, head of Beverly Creek. Believed to be derived from an inclusion of limestone in the peridotite.

	A.	B.	C.	D.	E.
SiO_2	64.04	63.37	63.78	39.00	32.12
Al_2O_3	15.58	15.90	16.39	1.75	.82
Fe_2O_3	1.26	1.41	1.12	5.16	2.05
FeO	3.22	3.18	2.76	1.71	3.50
MgO	3.23	3.33	3.27	38.00	26.73
CaO	4.51	4.63	4.07	trace	1.81
Na_2O	4.01	4.05	3.84	.10	.06
K_2O	2.22	2.10	2.03		
H_2O at 110°	.19	.18	.22	1.31	.43
H_2O above 110°	1.17	1.16	1.82	12.43	.98
TiO_2	.69	.69	.44	trace	trace
P_2O_5	.16	.17	.11	trace	trace
Cr_2O_3	none	none	none	.47	.27
NiO	none	none	none	.10	.08
MnO	trace	trace	.05	.15	.14
SrO	trace	none	trace	none	none
BaO	.11	.06	.08	none	none
Li_2O	trace	trace	trace	none	....
CO_2	none	none	none	none	31.04
S	trace	trace	trace	....	....
FeS_2 *a*	....	....	....	.03	none
	100.39	100.23	99.98	100.21	100.03

a Actual condition of sulphur not known.

F. Gabbro, east of Beverly Creek. Contains diallage and "basic" plagioclase, with pyrite and serpentine as alteration products.

G. Olivine-diabase, Camas Land. Contains augite, olivine, plagioclase, magnetite, and apatite.

H. Diabase, dike on ridge west of Turnpike Creek. Contains plagioclase, augite, olivine, magnetite, and apatite.

I. Basalt, middle fork of Teanaway River. Contains augite, plagioclase, magnetite, and apatite, with a glassy base.

	F.	G.	H.	I.
SiO_2	48.58	51.98	57.21	53.35
Al_2O_3	20.23	15.99	12.99	12.90
Fe_2O_3	1.26	3.10	3.28	2.64
FeO	3.02	5.88	10.18	11.28
MgO	7.59	5.09	1.59	2.68
CaO	14.01	9.68	5.97	6.96
Na_2O	2.25	2.71	3.07	2.83
K_2O	.19	.81	1.61	1.40
H_2O at 110°	.28	.48	.68	.91
H_2O above 110°	2.68	2.08	1.03	1.76
TiO_2	.09	1.71	1.72	2.44
P_2O_5	trace	.31	.44	.45
Cr_2O_3	trace	none	none	none
V_2O_3	....	....	none	.04
MnO	trace	.10	.24	.25
NiO	none	none	trace	trace
SrO	none	none	trace	trace
BaO	none	.03	.06	.05
Li_2O	none	trace	trace	trace
FeS_2	....	....	.13	.13
S	.10	.01	....	....
	100.25	99.96	100.20	100.07

ALASKA.

Rocks A to H, inclusive, were collected by G. F. Becker, who furnishes the petrographic data. A, B, C, D, F, and H are described by Becker in the 18th Ann., Part 3, p. 7. Analyses by Hillebrand, record No. 1585.

A. Augite-bronzite-andesite, Delarof Harbor, Unga Island. Greenish black. Contains plagioclase, near labradorite, with much smaller proportion of augite and bronzite, in a groundmass of plagioclase, with a little glass and much light-green indeterminate material. Contains 0.04 V_2O_3.

B. Augite-bronzite-andesite, St. Augustine Volcano, Cook Inlet. Purplish gray. Contains labradorite, augite, and bronzite, in a groundmass of plagioclase and magnetite.

C. Quartz-porphyry, bed of Bear Creek, 4 miles from its mouth, Turnagain Arm, Cook Inlet. Resembles D, with more feldspar and less quartz.

D. Quartz-porphyry, east of mouth of Indian River, Sitka, Baranof Island. Contains plagioclase, quartz, a little pyroxene, and some carbonaceous matter, with secondary quartz, calcite, and muscovite.

E. Diorite, head of Captains Bay, Unalaska Island. Contains plagioclase, biotite, hornblende, chlorite, magnetite, and sometimes tourmaline.

	A.	B.	C.	D.	E.
SiO_2	56.63	60.40	62.92	65.94	58.63
Al_2O_3	16.85	16.89	14.29	13.74	16.23
Fe_2O_3	3.62	1.88	.84	.49	1.91
FeO	3.44	3.72	4.66	5.21	4.20
MgO	4.23	3.82	3.14	2.33	4.28
CaO	7.53	7.25	2.72	2.87	6.59
Na_2O	3.08	3.80	4.30	2.80	3.51
K_2O	2.24	.77	1.39	1.63	2.09
H_2O at 110°	.80	.09	.22	.21	.15
H_2O above 110°	.51	.20	2.84	2.59	1.17
TiO_2	.67	.61	.84	.80	.74
P_2O_5	.16	.16	.13	.21	.20
NiO	trace?	.02	trace	trace?	.02
MnO	.23	.12	.15	.11	.11
SrO	trace	trace	trace	trace?	trace
BaO	.09	.06	.10	.12	.06
Li_2O	trace	trace	trace	trace	trace
CO_2	none	none	1.24	.59	none
C	....	....	....	.20	....
FeS_2	.06	.08	.32	.41	.04
	100.14	99.87	100.10	100.25	99.93

F. Diorite, Karluk Cliffs, Kadiak Island. Contains labradorite and hornblende, with subordinate quartz, biotite, and magnetite.

G. Diorite, Lane and Hayward mine, Silver Bow Basin. Contains plagioclase, biotite, hornblende, and scattering grains of quartz, with secondary chlorite, epidote, and muscovite.

H. Diorite, Treadwell mine, Douglas Island. Contains plagioclase, mostly albite, with secondary quartz, calcite, and pyrite, the latter apparently replacing ferromagnesian silicates. Contains 0.01 V_2O_3.

I. Hornblende-andesite, Bogoslof Island. Described by Merrill in Proc. U. S. National Museum, vol. 8, p. 31. Contains hornblende, augite, plagioclase, tridymite, grains of iron ore, a little apatite, and probably sanidine. P. R. C. 315.

J. Like I, but darker colored. Contains more hornblende, no glass, and little or no tridymite. Same locality, also described by Merrill. Analyses I and J, by T. M. Chatard, record Nos. 209, 210. P. R. C. 316.

	F.	G.	H.	I.	J.
SiO_2	61.58	54.20	63.01	56.07	51.54
Al_2O_3	15.89	15.86	18.48	19.06	20.31
Fe_2O_3	2.19	3.32	.06	5.39	4.64
FeO	5.50	4.14	.32	.92	3.56
MgO	2.69	3.51	.06	2.12	3.16
CaO	6.49	5.32	2.66	7.70	9.55
Na_2O	3.04	3.28	10.01	4.52	4.29
K_2O	.51	3.30	.39	1.24	2.47
H_2O at 110°	.16	.55	.05	} .99	} .34
H_2O above 110°	1.26	2.40	.27		
TiO_2	.63	1.35	.13	1.24	.32
P_2O_5	.12	.68	.06	.16	.57
NiO	trace ?	.02	none	....	....
MnO	.20	.19	.06	.23	.32
SrO	trace ?	.04	trace	....	....
BaO	.06	.41	.02	....	....
Li_2O	trace	trace	none	....	....
CO_2	none	1.45	2.01	....	....
FeS_2	.06	.26	2.10	....	....
	100.38	100.28	99.69	99.64	101.07

Rocks K to S. Collected by J. E. Spurr, who furnishes the petrographic notes. All but S are to appear in the 21st annual. Analyses by Stokes, record Nos. 1809 and 1822.

K. Alaskite, Chilkoot Pass. Dike in granite. Contains quartz, orthoclase, and some twinned feldspars, accessory zircon, actinolite, magnetite, and siderite.

L. Alaskite-porphyry, Fortymile Creek, near Canyon Creek. Dike. Contains quartz, orthoclase, and some plagioclase, with accessory biotite and epidote.

M. Alaskite, Skwentna River, 12 miles above its mouth. Dike. Contains quartz, orthoclase, and microcline, with no dark minerals.

N. Alaskite, Tordrillo Mountains. Dike. Consists of quartz, orthoclase, and microcline, with no dark minerals.

	K.	L.	M.	N.
SiO_2	76.30	67.01	75.01	77.33
Al_2O_3	12.50	17.91	13.88	12.55
Fe_2O_3 }	1.47	1.30	.74	.91
FeO }				
MgO	none	.42	.09	.10
CaO	.17	1.86	1.00	.17
Na_2O	3.86	5.33	3.52	3.19
K_2O	4.67	4.56	4.89	4.80
H_2O at 110°	.18	.16	.11	.15
H_2O above 110°	.32	.48	.26	.53
TiO_2	.05	.10	.06	.09
BaO	.07	.60	.10	trace
SrO	none	.13	trace	trace
Li_2O	none	none	trace	trace
	99.59	99.86	99.66	99.82

In K to N there are traces of P_2O_5 but no CO_2. Manganese is also present in traces.

O. Andesite-oligoclase-scapolite-biotite rock, Skwentna River, 15 miles above its mouth. Dike. Essential constituents andesine-oligoclase, scapolite, and biotite, with accessory apatite and zircon.

P. Augite-belugite, Skwentna River, near Hayes River. Dike. Contains essential feldspar, intermediate between andesine and labradorite, augite, and some hornblende. Also a considerable amount of pyrite.

Q. Tordrillite, Tordrillo Mountains. Dike. Contains phenocrysts of quartz, orthoclase, anorthoclase, and anorthoclase-albite. Groundmass consists of quartz and orthoclase. No dark minerals except very small quantities of secondary hornblende.

R. Augite-aleutite, near Kalinai Pass, Aleutian Peninsula. Lava. Chiefly labradorite, tending toward andesine, with a considerable amount of pale-green augite.

S. Tonalite-aplite, Yukon River, above Fort Hamlin. Dike. Consists essentially of quartz and soda-lime feldspars.

	O.	P.	Q.	R.	S.
SiO_2	62.78	50.23	75.84	56.03	74.79
Al_2O_3	17.16	19.46	13.38	18.31	12.59
Fe_2O_3	1.96	4.21	1.45	3.47	1.19
FeO	2.31	4.20		4.42	
MgO	2.32	3.59	.10	3.64	.31
CaO	4.84	10.39	.07	7.43	3.58
Na_2O	4.11	3.08	3.33	3.60	5.10
K_2O	2.15	1.32	4.73	1.18	.21
H_2O at 110°	.24	.16	.18	.12	.09
H_2O above 110°	.88	1.01	.71	.31	1.03
TiO_2	.56	1.30	.09	1.24	.17
P_2O_5	.15	.41	trace	.13	trace
MnO	.06	.07	trace	.11	trace
BaO	.04	.04	trace	trace	none
SrO	trace	trace	trace	trace	none
Li_2O	trace	trace	trace	trace	none
CO_2	none	.25	none	none	.58
S (*a*)	.02	.02	----------	trace	----------
Cl	trace	----------	----------	----------	----------
	99.58	99.74	99.88	99.99	99.64

a Whether S or SO_3 was not determined.

BRAZIL.

A kyanitic schist from Serra do Gigante, near Diamantina, was analyzed at the request of Prof. O. A. Derby, who describes the rock in Amer. Journ. Sci., 4th ser., vol. 7, p. 343. Analysis by Hillebrand, record No. 1783. Contains kyanite, chlorite, sericite, quartz, and rutile.

A. Bulk analysis of the schist.

B. Portion soluble in hydrochloric acid.

C. Portion soluble in strong sulphuric acid.

D. Residue insoluble in sulphuric acid.

The bracketed figures are deduced from other columns than the one in which they appear.

	A.	B.	C.	D.
SiO_2	38.32	10.78	14.76	[23.56]
Al_2O_3	28.16	10.42	14.77	[13.39]
Fe_2O_3	2.24	[1.78]	[2.24]	none
FeO	4.02	[3.21]	[4.02]	none
MgO	12.04	9.34	[12.04]	none
CaO	.32	.34	.32	....
Na_2O	.16	[.03]	[.03]	.13
K_2O	1.11	.26	[.26]	.85
H_2O at 105°	.55	[.55]	[.55]	....
H_2O above 105°	7.46	5.36	6.80	.66
TiO_2	4.93	.10	.20	[4.73]
P_2O_5	.47	.47	.47	....
ZrO_2	.09	trace	(?)	[.09]
CoO, NiO	.04	(?)	[.04]	....
MnO	.16	(?)	[.16]	....
SrO	trace	(?)	(?)	....
Li_2O	trace	trace	trace	trace
S	trace	....	....	....
F	trace?	....	....	....
	100.07	42.64	56.66	43.41

STONY METEORITES.

1. ROCKWOOD, TENNESSEE.

From the Crab Orchard Mountains, Cumberland County, Tennessee, about 8½ miles west of Rockwood. Analyzed by J. E. Whitfield, record No. 735, and described by him in Bull. 60, p. 103.

A. Analysis of the material as a whole.

B. Nickel-iron separated. Forms not over 16 per cent of the mass.

C. Nodule from meteorite.

D. Portion of nodule, 94 per cent, insoluble in hydrochloric acid. May be enstatite.

The stony part of the meteorite appears to be mainly pyroxene and anorthite. Fe_2O_3 was not determined, and FeO represents the total iron oxide.

	A.	B.	C.	D.
SiO_3	41.92	....	49.96	51.85
Al_2O_3	9.27	....	4.75	4.52
FeO	22.94	....	15.97	13.26
CaO	9.09	....	1.15	1.09
MgO	8.76	....	28.15	29.28
Fe	3.75	87.59	....	....
Ni	1.74	12.09	....	....
Co	trace	trace	....	....
Cu	trace	trace	....	....
P	.65	....	....	....
S	1.58	....	....	....
Cl	.18	....	....	....
	99.88	99.68	99.98	100.00

2. HAMBLEN COUNTY, TENNESSEE.

Mass of about half and half stone and iron found about 6 miles WSW. of Morristown. Analyzed by L. G. Eakins, and described in Bull. 113, p. 61.

A. The nickel-iron.

B. The part of the stony portion soluble in hydrochloric acid; 37.63 per cent, recalculated to 100, with sulphur deducted.

C. Insoluble part of the stony portion; 62.10 per cent, recalculated to 100.

A petrographic description of this meteorite is given by Merrill in Amer. Journ. Sci., 4th series, vol. 2, p. 149, together with an analysis of the feldspar. He finds it to contain, in addition to the nickel-iron, enstatite, diallage, anorthite, olivine or monticellite, oldhamite or secondary gypsum derived from oldhamite, lawrenceite, troilite, and schreibersite.

	A.		B.	C.
Fe	90.92	SiO_2	45.61	50.67
Ni	7.71	Al_2O_3	22.62	14.89
Co	.80	Cr_2O_3	....	1.32
Cu	trace	FeO	11.73	10.55
P	.19	NiO	1.06	....
S	.04	MnO	....	.76
	99.66	CaO	14.09	3.61
		MgO	3.64	17.98
		K_2O	....	.03
		Na_2O	....	.19
		P_2O_5	1.25	....
		S	....	....
			100.00	100.00

3. WINNEBAGO COUNTY, IOWA.

Fell May 2, 1890. Sp. gr. 3.804, 28°.5. Analyzed by L. G. Eakins, record No. 1190, and described in Bull. 78, p. 95.

Composition of the mass.

Nickel-iron	19.40
Troilite	6.19
Soluble silicates	36.04
Insoluble silicates	38.37
	100.00

Separate analyses:

A. The nickel-iron.

B. Silicate soluble in hydrochloric acid, calculated to 100 per cent.

C. Insoluble silicate, recalculated to 100 per cent. The Cr_2O_3 probably represents chromite.

	A.		B.	C.
Fe	92.65	SiO_2	39.74	55.51
Ni	6.11	Al_2O_3	....	5.43
Co	.65	Cr_2O_3	....	.25
P	trace	FeO	18.42	9.45
S	trace	NiO	.38	....
	99.41	MnO	trace	....
		CaO	.69	3.00
		MgO	40.77	24.09
		K_2O	trace	.15
		Na_2O	trace	2.12
		P_2O_5	trace	....
			100.00	100.00

4. TANEY COUNTY, MISSOURI.

Analysis by J. E. Whitfield, record No. 736. See Bull. 60, p. 106. Sp. gr., 4.484.

A. The separated nickel-iron.

B. The stony portion as a whole.

C. Silicates soluble in hydrochloric acid, recalculated to 100 per cent.

D. Insoluble silicates, recalculated to 100 per cent.

	A.		B.	C.	D.
Fe	89.41	SiO_2	45.88	26.95	52.39
Ni	10.41	Al_2O_3	7.89	17.69	7.11
Co	.29	FeO	19.73	35.98	14.68
P	.16	CaO	6.02	15.98	4.49
	100.27	MgO	17.96	3.40	21.33
		NiS	1.67		
		FeS	.54		
			99.69	100.00	100.00

5. WASHINGTON COUNTY, KANSAS.

Fell July 25, 1890. Analyzed by L. G. Eakins, record No. 1227, and described in Bull. 90, p. 45. Sp. gr. 3.49, 21.6°.

Composition of the mass.

Nickel-iron	7.7
Troilite	5.0
Soluble silicates	46.0
Insoluble silicates	41.5
	100.2

Separate analyses.

A. The nickel-iron.

B. Silicates soluble in hydrochloric acid, calculated to 100 per cent.

C. Insoluble silicates, calculated to 100 per cent.

	A.		B.	C.
Fe	86.76	SiO_2	38.50	53.80
Ni	12.18	Al_2O_3		4.32
Co	.83	Cr_2O_3		1.41
	99.77	FeO	23.54	11.98
		NiO	.69	
		CoO	trace	
		MnO	.34	trace
		CaO	.12	4.08
		MgO	36.81	22.37
		K_2O		.27
		Na_2O		1.77
			100.00	100.00

6. KIOWA COUNTY, KANSAS.

A pallasite found in Brenham Township. Analyzed by L. G. Eakins, record No. 1188, and described in Bull. 78, p. 94.

A. The nickel-iron. Sp. gr. 7.93, 23.4°.

B. The pure olivine. Sp. gr. 3.376, 23.2°.

C. Dark outer zone of olivine, containing troilite.

	A.		B.	C.
Fe	88.49	SiO_2	40.70	34.14
Ni	10.35	Al_2O_3	trace?	....
Co	.57	Fe_2O_3	.18	....
Cu	.03	FeO	10.79	23.20
P	.14	NiO	.02	trace
S	.08	CoO	....	.03
Si	trace?	MnO	.14	.09
C	trace	MgO	48.02	40.19
	99.66	S	....	5.42
			99.85	103.07
		Less O=S	....	2.71
				100.36

7. TRAVIS COUNTY, TEXAS.

Analyzed by L. G. Eakins, record No. 1097, and described in Bull. 78, p. 91. Sp. gr. 3.543, 20°. According to Cross, the stony portion contains olivine and enstatite, with a small amount of a colorless mineral, which is probably feldspar. Chromite is also present.

Approximate composition of the mass.

Nickel-iron	2.23
Troilite	5.03
Soluble silicates	39.84
Insoluble silicates	52.42
	99.52

A. Total analysis.
B. Nickel-iron.
C. Silicates soluble in hydrochloric acid, calculated to 100 per cent.
D. Insoluble silicates, calculated to 100 per cent.

	A.	B.	C.	D.
SiO_2	44.75		38.13	56.14
Al_2O_3	2.72		2.58	3.73
Cr_2O_3	.52			1.00
CuO	trace			
FeO	16.04		19.76	9.15
Fe	1.83	88.74		
NiO	.52		1.19	
Ni	.22	10.68		
Co	.01	.58		
MnO	trace			
CaO	2.23		1.02	3.59
MgO	27.93		37.32	24.44
K_2O	.13		undet.	.19
Na_2O	1.13		undet.	1.76
P_2O_5	.41			
S	1.83			
H_2O	.84			
	101.11	100.00	100.00	100.00
Less O = S	.92			
	100.19			

8. BLUFF, FAYETTE COUNTY, TEXAS.

Analyzed by J. E. Whitfield, record No. 824, and described in Bull. 60, p. 107. Sp. gr. 3.510. Examined microscopically by G. P. Merrill, who reports, in addition to nickel-iron and pyrrhotite, olivine, enstatite, and what appears to be augite or an allied pyroxene. See Amer. Journ. Sci., 3d series, vol. 36, August, 1888.

A. Total analysis.

B. Nickel-iron (5.67 per cent of total).

C. Part soluble in hydrochloric acid, calculated to 100 per cent (60.62 per cent of total).

D. Insoluble part, calculated to 100 per cent (33.3 per cent of total).

	A.	B.	C.	D.
SiO_2	37.70	....	33.59	49.64
Al_2O_3	2.17	....	1.34	4.12
FeO	23.82	....	31.12	15.56
Fe	4.41	82.42	....	....
NiO	1.59	....	2.66	trace
Ni	.88	15.44	....	....
CoO	.16	....	.27	trace
Co	.37	2.14	....	....
MnO	.45	....	.43	.54
CaO	2.20	....	1.00	4.93
MgO	25.94	....	28.08	25.21
P_2O_5	.25	....	.42	....
S	1.30	....	2.18	....
	101.24	100.00	101.09	100.00
Less O=S	.65	....	1.09	
	100.59	....	100.00	

This meteorite also contained a dark vein of sp. gr. 3.585, which carried 2.30 per cent of metallic iron. Analyses, made on less than 0.4 gramme of material, gave as follows, recalculated to 100 per cent:

E. Soluble in hydrochloric acid, metal deducted.

F. Insoluble.

	E.	F.
SiO_2	27.63	56.52
Al_2O_3	2.41	1.51
FeO	34.31	12.35
NiO+CoO	3.27	4.09
CaO	trace	trace
MgO	32.12	25.53
S	.52	....
	100.26	100.00
Less O=S	.26	
	100.00	

A represents 51 per cent and F 44 per cent of the vein.

9. SAN BERNARDINO COUNTY, CALIFORNIA.

Found in the San Emigdio Mountains. Analyzed by J. E. Whitfield, record Nos. 804 and 936, and described in Bull. 60, p. 114. In fragments, badly altered.

Approximate composition of the mass.

Nickel-iron	6.21
Soluble silicates, etc	51.26
Insoluble silicates	42.23
	99.70

The soluble part was probably olivine and pyrrhotite, with secondary iron oxide. The insoluble part was enstatite, essentially.

A. The nickel-iron.

B. The enstatite.

	A.		B.
Fe	88.25	SiO_2	54.42
Ni	11.27	FeO	14.03
Co	.48	CaO	2.46
	100.00	MgO	29.11
			100.02

10. BEAVER CREEK, BRITISH COLUMBIA.

Fell May 26, 1893, near Beaver Creek, West Kootenai district. Described by Howell, Hillebrand, and Merrill in Amer. Journ. Sci., 3d series, vol. 47, p. 430.

Composition of the mass.

Nickel-iron	17.13
Magnetite	.16
Troilite	5.05
Soluble silicates and phosphate	37.23
Insoluble silicates and chromite	40.43
	100.00

According to Merrill, the silicates visible are olivine, enstatite, probably a little plagioclase, and some glassy base.

Analyses by W. F. Hillebrand, record No. 1444.

A. Nickel-iron.

B. Nonmagnetic, stony portion.

C. Portion of B soluble in hydrochloric acid, calculated to 100 per cent.

D. Insoluble portion, calculated to 100 per cent. From C and D troilite and chromite are excluded. The chromite forms about 0.75 per cent of the stony matter.

	A.		B.	C.	D.
Fe	90.68	SiO_2	45.87	38.26	57.75
Ni	8.80	TiO_2	.09	....	.18
Co	.49	Al_2O_3	2.30	.56	4.89
Cu	.03	Cr_2O_3	.51	....	....
	100.00	FeO	12.68	19.52	8.02
		Fe	3.87	....	....
		NiO	.07	.09	trace
		MnO	.26	.27	.35
		CaO	1.96	1.03	3.44
		MgO	28.24	38.74	23.19
		K_2O	.15	.02	.25
		Na_2O	.98	.13	1.87
		H_2O	.34	.70	.06
		P_2O_5	.30	.68	....
		S	2.21	....	....
		Cl	trace	trace	....
			99.83	100.00	100.00
		Troilite	6.08		
		Chromite	.75		

11. LLANO DEL INCA, CHILE.

Analyzed by L. G. Eakins, record No. 1201, and described in Bull. 78, p. 97.

Approximate composition of the mass.

Nickel-iron	25.8
Troilite	10.6
Soluble silicates	30.9
Insoluble silicates	32.6
	99.9

Separate analyses.

A. The nickel-iron.

B. Silicates soluble in hydrochloric acid, calculated to 100 per cent.

C. Insoluble silicates, calculated to 100 per cent.

Is the P_2O_5 in B derived from schreibersite?

	A.		B.	C.
Fe	89.77	SiO_2	28.08	53.11
Ni	9.17	Al_2O_3	12.74	2.32
Co	.61	Cr_2O_3	....	.90
	99.55	FeO	42.52	18.82
		NiO	2.90	....
		MnO	.20	....
		CaO	9.33	1.75
		MgO	1.98	23.10
		P_2O_5	2.25	....
			100.00	100.00

METEORIC IRON.

A. The Mount Joy meteorite, found near Two Taverns post-office, near Gettysburg, Pennsylvania. Analysis by L. G. Eakins, record No. 1318.

B. From Pulaski County, Virginia. Sp. gr. 7.95, 23°. Analysis by Eakins, No. 1228. Described by Eakins in Bull. 90, p. 45.

C. From Ellenboro, Rutherford County, North Carolina. Described and analyzed by Eakins, Bull. 78, p. 93. Record No. 1160.

D. From Linnville Mountain, North Carolina. Analyzed by J. E. Whitfield, record No. 822, and described in Bull. 60, p. 107. Sp. gr. 7.778.

E. From Cherokee County, Georgia. Analysis by H. N. Stokes, record No. 1527.

	A.	B.	C.	D.	E.
Fe	93.80	93.59	88.05	84.56	91.96
Ni	4.81	5.56	10.37	14.95	6.70
Co	.51	.53	.68	.33	.50
Cu	.005	trace	.04	....	.03
P	.19	.27	.21	trace	.11
S	.01	.01	.08	.12	.01
Si	....	trace	.02	none	trace
C	....	....	....	trace	trace?
	99.325	99.96	99.45	99.96	99.31

F. From near Holland's store, Chattooga County, Georgia. Analysis by J. E. Whitfield, record No. 765. See Bull. 60, p. 106. Sp. gr. 7.801.

G. From Hamilton County, Texas. Sp. gr. 7.95, 27°. Analysis by L. G. Eakins, record No. 1189. See Bull. 78, p. 95.

H. From near Scottsville, Allen County, Kentucky. Analysis by Whitfield, record No. 509. See Bull. 55, p. 64.

I. Fell 6 miles east of Cabin Creek, Johnson County, Arkansas, March 27, 1886. Analysis by Whitfield, record No. 505. See Bull. 55, p. 63.

J. From near Grand Rapids, Michigan. Sp. gr. 7.87. Analysis by R. B. Riggs, record No. 296. See Bull. 42, p. 94.

	F.	G.	H.	I.	J.
Fe	94.60	86.54	94.32	91.87	88.71
Ni	4.97	12.77	5.01	6.60	10.69
Co	.21	.63	trace	trace	
Cu		.02			.07
Mg					.02
Mn				trace	
P	.21	.16	.16	.41	.26
S	trace	.03	.34	.05	.03
Si			none		
C	trace	.11	.12	.15	.13
Insoluble				.34	
	99.99	100.26	99.95	99.42	99.91

K. The El Capitan iron, from near Bonito, New Mexico. Analysis by H. N. Stokes, record No. 1527.

L. From La Bella Roca, Sierra de San Francisco, Mexico, State of Durango. Analysis by J. E. Whitfield, record No. 1037. Bull. 64, p. 28.

M. Troilite nodule from L, outer part, somewhat altered.

N. Troilite nodule M, inner part. Analyses L and M also by Whitfield, record No. 1037.

O. From Puquios, Chile. Sp. gr. 7.93, 25.2°. Analysis by L. G. Eakins, record No. 1181. See Bull. 78, p. 95.

P. The Abert iron, of unknown origin. Analysis by R. B. Riggs, record No. 356. Sp. gr. 7.89. See Bull. 42, p. 94.

	K.	L.	M.	N.	O.	P.
Fe	90.51	91.48		9.37	88.67	92.07
Ni	8.40	7.92			9.83	7.01
Co	.60	.22			.71	.66
Cu	.05				.04	
P	.24	.21			.17	.08
S	trace	.21			.09	.01
Si					trace?	
C		.06			.04	.05
NiS			2.07	2.13		
FeS			37.51	85.27		
Fe_2O_3			37.80			
Moisture			19.85			
	99.80	100.10	97.23	96.77	99.55	99.88

The two following meteoric irons were analyzed by L. G. Eakins in the Denver laboratory.

A. Found near Albuquerque, New Mexico. Described by Eakins in Proc. Colorado Sci. Soc., vol. 2, p. 14.

B. From Wyoming. Partial analysis.

	A.	B.
Fe	88.76	89.26
Ni	9.86	5.94
Co	.51	.78
Cu	.034	----------
Zn	.03	----------
Mn	trace	----------
P	.182	.24
S	.012	----------
Si	.044	----------
C	undet.	----------
	99.432	96.22

SANDSTONES, CHERTS AND SINTERS.

SANDSTONES FROM OHIO.

A. Blue sandstone from near Cleveland. Analysis by T. M. Chatard, record No. 214.

B. Sandstone from Berea. Analysis by L. G. Eakins, record No. 914.

C, D, E. Three samples of the "Peebles-Henley sandstone," from Portsmouth. Analyses by H. M. Stokes, record No. 1239. Alkalies, etc., undetermined.

	A.	B.	C.	D.	E.
SiO_2	91.67	92.91	90.40	89.32	87.12
Al_2O_3	6.92	3.78	5.15	5.52	5.96
Fe_2O_3	trace	trace	.65	.87	.85
FeO	----------	.91	.27	.35	.85
MgO	.34	trace	.28	.51	.73
CaO	.28	.31	----------	----------	----------
Na_2O	----------	.34	----------	----------	----------
K_2O	----------	.61	----------	----------	----------
H_2O	1.17	1.19	.99	1.49	2.00
	100.38	100.05	97.74	98.06	97.51
Insol. in HCl	97.50	----------	98.00	96.90	95.52

SANDSTONES FROM CALIFORNIA.

1. SANDSTONES FROM MOUNT DIABLO.

Described by Turner and Melville in Bull. Geol. Soc. Amer., vol. 2, pp. 383–414. Analyses made by W. H. Melville in the San Francisco laboratory.

A. Upper Cretaceous, Chico sandstone. Light brown, finely granular, carrying grains of mica and feldspar.

B. Lower Cretaceous, Neocomian sandstone. Hard, granular, greenish. From head waters of Bagley Creek.

C. Miocene sandstone. Granular, particles light brown and black, friable. From near Wall Point.

D. Chico sandstone. Greenish gray, compact, crystalline.

	A.	B.	C.	D.
SiO_2	73.71	56.84	44.54	36.93
Al_2O_3	10.40	11.37	12.63	7.22
Fe_2O_3	3.89	1.46	2.50	1.59
FeO	1.88	4.95	3.08	2.95
MgO	1.62	3.10	5.55	2.34
CaO	.96	7.62	14.65	29.34
Na_2O	3.48	3.26	3.35	2.94
K_2O	.99	.86	1.37	.64
H_2O at 100°	1.06	1.45	1.43	.57
H_2O above 100°	2.60	3.34	2.25	3.45
P_2O_5	none	.10	.29	.16
MnO	.17	.22	.44	.57
CO_2	none	5.10	7.76	*a* 11.30
	100.76	99.67	99.84	100.00

a CO_2 determined by difference.

Traces of organic matter are found in all four sandstones, but were not determined.

2. SANDSTONE DIKES IN SHASTA COUNTY.

Described by J. S. Diller in Bull. Geol. Soc. Amer., vol. 1, p. 411. The rock is made up of quartz, feldspar, and biotite, with a calcite cement. Serpentine, sphene, magnetite, and zircon also occur in it, but are less common.

A. From Salt Creek, one half mile above McNett's.

B. One and one-fourth miles below Ono Bridge, north fork of Cottonwood.

C, D. Three-fourths of a mile below John Allen's, Dry Creek.

E. From John Allen's, Dry Creek.

Analyses A and B by T. M. Chatard, record No. 1106; C, D, and E by J. E. Whitfield, record Nos. 972, 973.

	A.	B.	C.	D.	E.
SiO_2	48.13	48.10	59.10	61.60	54.55
Al_2O_3	11.19	12.16	14.02	12.15	10.64
Fe_2O_3	1.25	1.02	3.16	2.09	1.59
FeO	1.47	2.14	1.42	3.30	1.16
MgO	2.22	1.65	1.72	2.33	1.29
CaO	16.39	15.88	9.35	6.92	14.30
Na_2O	2.29	2.46	2.21	2.16	2.60
K_2O	1.17	1.56	1.49	1.41	1.68
H_2O at 110°	.78	.46			
H_2O at red heat	1.78	3.27	2.63	3.10	1.60
TiO_2	.24	.47	.70	trace	trace
P_2O_5	.14	.13	trace	.08	.10
MnO	.29	.26	trace	trace	1.53
BaO	.04	undet.			
CO_2	12.73	10.36	4.65	5.05	9.05
SO_3			trace	.27	.10
Cl			trace	trace	.72
	100.11	99.92	100.45	100.46	100.31

The following bedded sandstones of the same region are also described:

F. From middle fork of Cottonwood, 1 mile above Miller's.

G. Top of cascade, $1\frac{1}{2}$ miles up Byron Creek from north fork of Cottonwood.

H. Two and one-half miles above John Allen's, Dry Creek.

Analyses F and G by Chatard, record No. 1106; H by Whitfield, record No. 974.

	F.	G.	H.
SiO_2	55.85	67.62	60.74
Al_2O_3	13.20	13.63	10.25
Fe_2O_3	2.56	1.25	4.31
FeO	4.77	3.27	6.21
MgO	1.90	2.34	3.69
CaO	6.93	2.80	4.97
Na_2O	2.60	2.78	1.83
K_2O	1.89	1.11	.52
H_2O at 110°	1.13	.64	
H_2O at redness	2.99	2.83	4.36
TiO_2	.76	.48	.86
P_2O_5	.18	.08	trace
MnO	.24	.15	trace
BaO	undet.	.03	
CO_2	4.97	.72	2.29
SO_3			.40
Cl			trace
	99.97	99.73	100.43

3. SANDSTONE FROM SULPHUR BANK.

Described by Becker in Mon. XIII, p. 92. Analysis made by Melville in the San Francisco laboratory. An altered sandstone, showing grains of quartz, plagioclase, and orthoclase.

SiO_2	68.50	H_2O at 100°	.28
Al_2O_3	12.82	H_2O above 100°	2.11
Fe_2O_3	1.29	TiO_2	.60
FeO	3.37	P_2O_5	.16
MgO	2.21	MnO	.02
CaO	1.82		100.47
Na_2O	6.03		
K_2O	1.26		

MISCELLANEOUS SANDSTONES.

A. Triassic sandstone from the Jaittelle quarry, near Hancock, Maryland. Hard, compact, brown. Analysis by F. W. Clarke, record No. 613.

B. Brown sandstone, Hummelstown, Pennsylvania. Analysis by E. A. Schneider, record No. 1280. Described by Diller in Bull. 150, p. 77. P. R. C. 14.

C. Yellow sandstone from Stony Point, Michigan. Analysis by F. W. Clarke, record No. 213.

D. Carboniferous sandstone adjoining the peridotite dike of Elliott County, Kentucky. See Diller, Amer. Journ. Sci., 3d series, vol. 32, p. 125. Analysis by T. M. Chatard, record No. 354.

E. Yellow sandstone, Armejo quarry, Colorado. Analysis, partial, by T. M. Chatard, record No. 289.

	A.	B.	C.	D.	E.
SiO_2	76.43	88.13	84.57	60.78	81.27
Al_2O_3	17.78	5.81	5.90	10.54	9.81
Fe_2O_3		1.77	6.48	3.27	1.44
FeO	....	.31	....	....	....
MgO	.92	.53	.68	1.59	.42
CaO	.84	.20	....	10.15	.44
Na_2O	undet.	.06	undet.	1.41	undet.
K_2O	undet.	2.63	undet.	2.36	undet.
H_2O at 100°	2.79	.23	1.92	.85	1.19
H_2O above 100°		.26		2.32	
TiO_2	....	....	....	.03	....
P_2O_5	....	....	....	.09	....
MnO	trace	....	....	.10	....
CO_2	....	....	....	6.29	....
	98.76	99.93	99.55	99.78	94.57
Insol. in HCl	88.68	....	91.87	....	95.54

F. Potsdam sandstone, Ablemans, Sauk County, Wisconsin. Described by Diller in Bull. 150, p. 80. Analysis by Schneider, record No. 1280. P. R. C. 15.

G. Banded sandstone, Peoa, Utah. Described by Diller in Bull. 150, p. 80. Analysis by Schneider, record No. 1280. P. R. C. 16.

H. Brown sandstone, Flagstaff, Arizona. Analysis by T. M. Chatard, record No. 1144.

I. Sandstone, Robinson mine, Summit County, Colorado. Analysis by L. G. Eakins, made in the Denver laboratory, partial.

	F.	G.	H.	I.
SiO_2	99.42	96.60	a79.19	56.33
Al_2O_3	.31	2.02	1.30	.77
Fe_2O_3			2.45	.97
MgO		.08	.23	7.30
CaO		.04	7.76	14.01
Na_2O				undet.
K_2O				undet.
H_2O at 100°	.18	.11	.32	undet.
H_2O above 100°		.29	2.94	undet.
CO_2			5.77	b19.04
	99.91	99.14	99.96	98.42

a Silica and insoluble matter.

b Calculated for bases.

CHERT.

From the lead-zinc region of southwestern Missouri and its extension into Kansas.

Collected by W. P. Jenney.

A. Unaltered chert, East Hollow, Belleville, Jasper County, Missouri.

B. Partly altered, same locality.

C. Altered to "cotton rock," same locality.

D. From the Surprise mine, Joplin, Missouri.

Analyses by E. A. Schneider, record No. 1205.

	A.	B.	C.	D.
SiO_2	98.17	98.92	98.71	99.46
Al_2O_3, Fe_2O_3	.83	.48	.43	.29
MgO	.01	.02	.02	trace
CaO	.05	.03	.03	.04
Ignition	.78	.42	.50	.34
	99.84	99.87	99.69	100.13

E. Blue chert, unaltered, Bonanza shaft, Galena, Kansas.

F. Same locality.

G. Altered, same locality.

H. Jasperite, Joplin, Missouri.

I. Jasperite, Galena, Kansas.

Analyses E, F, and G by E. A. Schneider, record No. 1205; H and I by L. G. Eakins, record No. 1208.

	E.	F.	G.	H.	I.
SiO_2	99.23	98.60	99.13	95.77	97.33
Al_2O_3, Fe_2O_3	.22	.52	.16	1.84	1.89
MgO	trace	trace	.01	.24	.09
CaO	.02	.10	trace	.54	.11
Ignition	.50	.40	.20	1.17	.77
	99.97	99.62	99.50	99.56	100.19

SILICEOUS SINTERS.

From the Yellowstone National Park and similar localities. Described by W. H. Weed in 9th Ann., p. 619. Analyses A to H, inclusive, by J. E. Whitfield, record Nos. 97, 100, 707, 708, 812, and 998; analysis I by E. A. Schneider, record No. 1254. A to E from Yellowstone National Park.

A. Dried siliceous jelly from Emerald Spring, Upper Basin.
B. Sinter from Solitary Spring, Upper Basin.
C. Grayish sinter from margin of Splendid Geyser.
D. Compact sinter from Old Faithful Geyser.
E. From Asta Spring, Hillside Group.
F, G, H. Three samples of sinter from Rotorua, New Zealand. For comparison with Yellowstone sinters.
I. Sinter from Mount Morgan gold mine, Queensland, Australia. Described by Weed in Am. Journ. Sci., 3d series, vol. 42, p. 165.

	A.	B.	C.	D.	E.
SiO_2	93.37	93.88	81.95	89.54	89.72
Al_2O_3	1.16	1.73	6.49	2.12	} 1.02
Fe_2O_3	trace	.14	trace	trace	
MgO	.05	.07	.15	trace	trace
CaO	.29	.25	.56	1.71	2.01
Na_2O	.11	.28	2.56	1.12	.....
K_2O	.02	.23	.65	.30	.....
H_2O (ign.)	4.17	3.37	7.50	5.13	7.34
NaCl	.08	.18	trace	trace	.....
SO_3	.31	.20	.16	trace	trace
C, organic	.78	.....	.....	.....	.....
H, organic	.07	.....	.....	.....	.....
	100.41	100.33	100.02	99.92	100.09

	F.	G.	H.	I.
SiO_2	92.47	90.28	74.63	94.02
Al_2O_3	2.54	3.00	15.59	} 2.27
Fe_2O_3	.....	.....	.....	
MgO	.15	trace	trace	trace
CaO	.79	.44	1.00	.07
Na_2O	.....	.....	.30	.....
K_2O	.....	.....	1.02	.....
H_2O at 105°	.....	.....	.....	1.07
Ignition	3.99	6.24	7.43	2.29
	99.94	99.96	99.97	99.72

THE CARBONATE ROCKS: LIMESTONE, DOLOMITE, SIDERITE, ETC.

VERMONT AND MASSACHUSETTS.

A. White marble, Rutland, Vermont. Analysis by L. G. Eakins, record No. 1213.

B. The portion of A insoluble in dilute hydrochloric acid. Same analyst and number.

C. White marble, Lee, Massachusetts. Analysis by E. A. Schneider, record No. 1279. Described by Diller in Bull. 150, p. 299. P. R. C. 116.

D. Limestone, Lee, Massachusetts. Collected by B. K. Emerson. From cut on west side of railroad. Analysis by George Steiger, record No. 1654.

E. Dolomite, Charlemont, Massachusetts. Collected by Emerson. Analysis by Eakins, record No. 1343.

F. Dolomite, Webster, Massachusetts. Collected by Emerson. Analysis by H. N. Stokes, record No. 1634.

	A.	B.	C.	D.	E.	F.
Insoluble	8.00		.19			
SiO_2		56.69		.95	.67	1.01
Al_2O_3	.39	31.16	.24	.09	trace	.17
Fe_2O_3				none	.08	none
FeO	.14	2.13		.10	7.60	.37
MnO					1.61	.08
NiO					.03	
CaO	50.79	2.68	30.88	54.75	28.63	30.82
MgO	trace	3.27	21.42	.56	16.17	21.35
K_2O		undet.		.15		.10
Na_2O		undet.		.02		.01
H_2O	1.01			.08		.09
P_2O_5				.03		.06
CO_2	39.80		46.72	43.38	45.35	45.84
SO_3				.05		
	100.13	95.93	99.45	100.16	100.14	99.90

NEW YORK, PENNSYLVANIA, MARYLAND.

A. Dolomite-marble, New York Quarry Company, Tuckahoe, Westchester County, New York. Analysis by W. F. Hillebrand, record No. 746.

B. Hydraulic-cement rock, Akron, New York. Analysis by George Steiger, record No. 1655.

C. Compact gray limestone, Greason, Pennsylvania. Analysis by E. A. Schneider, record No. 1279.

D. Dolomite-marble, Cockeysville, Maryland. Analysis by Schneider, No. 1279. P. R. C. 117.

E. An earlier sample of D. Analysis by J. E. Whitfield, record No. 827. P. R. C. 117.

Rocks B, C, D, E are described by Diller in Bull. 150, pp. 127, 133, 300.

	A.	B.	C.	D.	E.
Insoluble	1.33		11.07	5.57	
SiO_2		9.03			.44
TiO_2		.16			
Al_2O_3		2.25		.40	1.22
Fe_2O_3	.21	.85			
FeO		.52			trace
CaO	30.68	26.84	39.26	29.08	30.73
MgO	20.71	18.37	9.00	20.30	20.87
K_2O		.85			
Na_2O		none			
H_2O	.16	.98	.18		1.22
P_2O_5		.03			
CO_2	46.66	40.33	38.82	44.26	45.85
Organic matter			.75		
	99.75	100.21	99.08	99.61	100.33

VIRGINIA AND WEST VIRGINIA.

A. Limestone, upper ledge, Moundsville Narrows, West Virginia.

B. Same as A, lower ledge. Analysis A and B by T. M. Chatard, record No. 127.

C. Trenton limestone, Lexington, Virginia. Analysis by R. B. Riggs, record No. 365.

D. Limestone, Staunton, Virginia. Analysis by George Steiger, record No. 1630.

E. Part of D insoluble in one-tenth hydrochloric acid.

F. Soluble part of D. Analyses E and F also by Steiger, same number. These three analyses are accompanied by analyses of the residual clay, formed by the weathering of the limestone. See section on clays.

	A.	B.	C.	D.	E.	F.
Insoluble	10.33	1.53				
SiO_2			.44	7.37	6.98	.39
TiO_2				.09	.09	none
Al_2O_3				1.92	1.39	.53
Fe_2O_3	.90	.96	.42	29	.25	.04
FeO				.63	none	.63
MnO	trace	trace		none	none	none
CaO	48.02	53.26	54.77	28.39	.04	28.35
MgO	1.08	.93	trace	18.30	.15	18.15
K_2O				1.09	.91	.18
Na_2O				.09	.04	.05
H_2O at 100°	.05	.10	1.08	.09	undet.	undet.
H_2O above 100°				.49	.15	.34
P_2O_5	trace	trace		.03	none	.03
CO_2	39.18	43.16	42.72	41.85	none	41.85
	99.56	99.94	99.43	100.63	10.00	90.54

GEORGIA.

A. Marble, Happy Valley.
B. "Creole" marble, Happy Valley.
C. Portion of B insoluble in dilute hydrochloric acid.
D. "Cherokee" marble, Happy Valley.
E. Portion of D insoluble in dilute hydrochloric acid.
Analyses by L. G. Eakins, record Nos. 464, 485.

	A.	B.	C.	D.	E.
Insoluble	....	1.84	....	2.01	....
SiO_2	2.23	....	58.21	....	55.48
Al_2O_3	.91	.17	7.37	.15	15.58
Fe_2O_3	.22	....	....	....	....
FeO	....	.05	.31	.06	trace
CaO	52.16	53.91	12.53	53.69	14.52
MgO	2.09	.83	20.42	.83	12.88
H_2O	.45	.13	....	.17	....
CO_2	42.22	43.16	....	43.13	....
	100.28	99.69	98.84	100.04	98.46

FLORIDA.

1. CORAL AND SHELL ROCKS, COLLECTED BY N. S. SHALER.

Partial analyses only. Chlorides and sulphates present; alkalies and phosphates not looked for.
A, B, C, D. Coquina gravel, Tortugas.
E. The same, Key West.
Analyses by F. W. Clarke, record No. 878.

	A.	B.	C.	D.	E.
SiO_2	.19	.22	.32	.21	.25
Al_2O_3, Fe_2O_3	.19	.47	.56	.76	.56
CaO	52.24	51.24	49.38	51.95	51.52
MgO	1.53	2.09	1.93	1.44	2.08
CO_2	41.46	41.07	40.39	41.53	41.58
H_2O	3.27	3.57	5.12	3.07	3.19
	98.88	98.66	97.70	98.96	99.18

F. Near Fort Worth.
G. East side of St. Johns River, near Seville.
H. Corroded surface, Miami Reef.
I. Near Oak Hill.
J. Near Melborne.
Analyses by F. W. Clarke, record No. 885.

	F.	G.	H.	I.	J.
SiO_2	2.94	8.50	2.99	5.87	17.83
Al_2O_3, Fe_2O_3	.23	.73	.65	.95	1.18
CaO	51.51	47.29	51.22	50.34	43.85
MgO	.71	1.51	.06	.37	.26
CO_2	41.59	39.00	41.22	39.62	34.31
H_2O	2.64	3.37	2.23	3.21	2.53
	99.62	100.40	98.37	100.36	99.96

K. Coarse shell mass, Senote.
L. Coral rock, Salt Key Bank.
M. Loggerhead Key.
Analyses by L. G. Eakins, record No. 882. The following analyses, also by Eakins, No. 883, are included for comparison:
N. Coralline bottom, Barbados.
O. Recent coral (Siderostria), Bermuda.

	K.	L.	M.	N.	O.
SiO_2	.22	.11	.20	1.17	.23
Al_2O_3, Fe_2O_3	.18	.04	.22	.31	trace
CaO	54.87	53.54	53.54	46.45	55.16
MgO	.64	.71	.78	5.15	.20
CO_2	43.89	43.87	43.71	43.40	43.74
H_2O	.11	1.13	.81	2.73	.54
	99.91	99.40	99.26	99.21	99.87

2. MISCELLANEOUS ROCKS.

A to M inclusive. Thirteen borings from the artesian well at Key West. Partial analyses by Steiger, record No. 1553. The figures at tops of columns give depths in feet from which samples were taken.

	A.	B.	C.	D.	E.	F.
	25	100	150	350	600	775
SiO_2	.17	.25	.12	3.52	5.10	.13
Al_2O_3	.20	.17	.08	.40	.35	.14
Fe_2O_3	.07	.07				
CaO	54.03	54.01	54.38	51.46	48.87	46.53
MgO	.29	.77	.86	1.67	2.50	6.70
CO_2	42.52	42.84	43.36	41.77	40.72	43.60
	97.28	98.11	98.80	98.82	97.54	97.10

	G.	H.	I.	J.	K.	L.	M.
	1125	1325	1400	1475	1625	1850	2000
SiO_2	.05	.07	.19	.06	.05	.03	.07
Al_2O_3, Fe_2O_3	.21	.11	.16	.14	.17	.17	.16
CaO	53.84	54.49	55.12	54.48	53.90	54.28	54.02
MgO	.86	.62	.30	.73	1.14	1.12	1.06
CO_2	42.87	43.29	43.28	43.38	43.37	43.13	43.20
	97.83	98.58	99.05	98.79	98.63	98.73	98.51

P_2O_5 is present. Is included with Al_2O_3 and Fe_2O_3.

N. Supposed cement rock, River Junction. Received from D. T. Day. Analysis by George Steiger; record No. 1844.

SiO_2	12.31
Al_2O_3	12.19
Fe_2O_3	.66
CaO	26.28
MgO	16.72
K_2O	none
Na_2O	.50
H_2O at 100°	.94
H_2O above 100°	2.05
P_2O_5	.05
CO_2	38.12
	99.82

TENNESSEE, ALABAMA, LOUISIANA.

A. Limestone, Knoxville, Tennessee. Analysis by L. G. Eakins, record No. 1159.

B. Knox dolomite, Morrisville, Alabama. Described by Russell in Bull. 52, together with a residual clay derived from it. See section on clays. Analysis by W. F. Hillebrand, record No. 797.

C. Limestone from Rayborn's salt-lick, Bienville Parish, Louisiana. Analysis by R. B. Riggs, record No. 323.

D. White marble, streaked with black. From 5 miles west of Winnfield, Louisiana. Analysis by W. F. Hillebrand, record No. 760. In addition to the constituents named in the table, this marble contains traces of barium, strontium, chlorine, and organic matter.

	A.	B.	C.	D.
Insoluble				.65
SiO_2	.17	3.24	.55	
Al_2O_3	.04	.17	1.61	trace
Fe_2O_3	.23	.17		
FeO		.06		trace
MnO			trace	.10
CaO	55.47	29.58	54.09	55.01
MgO	.30	20.84	.06	.60
H_2O	.21	.30		.13
P_2O_5			.05	
CO_2	43.63	45.54	44.12	43.43
SO_3			.05	.27
	100.05	99.90	100.53	100.19

TEXAS.

Supposed cement rock, Uvalde quadrangle. Collected by T. Wayland Vaughan. Analysis by W. F. Hillebrand, record No. 1759.

A, the rock; B, the part insoluble in dilute nitric acid.

	A.		B.
SiO_2	.10	SiO_2	20.80
Fe_2O_3, Al_2O_3	.09	Al_2O_3, Fe_2O_3, P_2O_5	3.44
CaO	40.82	H_2O	1.14
MgO	.18	Alkalies	.19
CO_2	32.41		25.57
Insoluble	25.57		
NaCl, Mn, H_2O *a*	.83		
	100.00		

a By difference.

OHIO.

A, B, C, D. Trenton limestone from New Vienna.

Partial analyses by F. W. Clarke and R. B. Riggs, record Nos. 729, 730, 732. Iron and alumina are present in soluble form.

	A.	B.	C.	D.
Insoluble	8.47	9.93	2.12	28.43
CaO	47.16	49.04	51.18	23.00
MgO	1.52	.58	3.08	12.90
CO_2	36.20	37.64	42.04	30.82
	92.35	97.19	98.42	95.15

E. Trenton limestone, Arcadia, Hancock County.

F. Air-line Junction, Toledo. This sample contains a great deal of ferrous carbonate.

G. Gas rock, St. Henry's well, Mercer County.

H. Oil rock, Lima.

All Trenton. Analyses, partial, by Clarke and Riggs, record Nos. 729, 730.

	E.	F.	G.	H.
Insoluble	8.56	3.52	2.27	1.64
CaO	47.17	30.64	50.34	32.24
MgO	2.59	18.05	2.86	17.36
CO_2	38.54	42.82	40.96	43.92
	96.86	95.03	96.43	95.16

The following partial analyses by F. W. Clarke, record No. 738, all relate to Trenton limestones:

A. Well No. 3, Bryan. Gas rock.
B. McElree well, Kenton. Depth, 1,315 feet.
C. Huntsville. Depth, 1,405 feet.
D. Prospect. Depth, 1,650 feet.
E. Findlay street well, Dayton. Depth, 975 feet.
F. Xenia. Depth, 1,075 feet.
G. New Madison. Depth, 1,150 feet.

	A.	B.	C.	D.
Insoluble	9.22	5.26	4.41	26.12
Fe_2O_3, Al_2O_3	1.51	1.10	3.15	2.57
$CaCO_3$	49.00	84.32	57.23	66.02
$MgCO_3$	38.59	8.43	33.16	3.77
	98.32	99.11	98.95	98.58

	E.	F.	G.
Insoluble	12.34	9.23	11.11
Fe_2O_3, Al_2O_3	.58	.18	3.60
$CaCO_3$	82.36	86.54	64.91
$MgCO_3$	1.67	2.99	17.98
	96.95	98.94	97.60

In C and G there is ferrous carbonate.

Partial analyses by Charles Catlett, record Nos. 754, 755, 756, 757; all of Trenton limestones from the natural-gas belt.

A. London. Depth, 1,594 feet.
B. Air-line Junction, Toledo. Depth, 1,415 feet.
C. Celina. Depth, 1,112 feet.
D. City well No. 2, Upper Sandusky.
E. Sandusky. Depth, 2,260 feet.
F. Gas rock. Pauck well, St. Marys Township, Auglaize County.
G. Gas rock. Bennett well, St. Marys Township. Depth, 1,121 feet.
H. First city well, Carey. Depth, about 1,350 feet.
I. Well No. 2, Fort Recovery. Depth, 1,065 feet.
J. Waggoner well, 6 miles west of Fremont. Gas rock.
K. Loomis and Nyman well, Tiffin. Depth, 1,470 to 1,481 feet.
L. Loomis and Nyman well, Tiffin. Depth, 1,488 to 1,494 feet.
M. Port Clinton. Depth, 1,660 to 1,700 feet.
N. Wauseon. Depth, 2,135 feet.
O. Napoleon. Depth, 1,830 feet.
P. Kossuth, Allen County. Oil rock.
Q. Doenze's well, Franklin Township, Mercer County. Depth, 1,107 feet.

	A.	B.	C.	D.	E.	F.
Insoluble	15.90	2.88	2.95	8.18	3.65	3.18
Al_2O_3, Fe_2O_3	1.84	8.68	2.95	4.31	4.58	3.12
$CaCO_3$	77.69	54.68	68.41	64.25	54.62	52.18
$MgCO_3$	1.89	25.73	24.18	15.93	33.67	38.42
	97.32	91.97	98.49	92.67	96.52	96.90

	G.	H.	I.	J.	K.	L.
Insoluble	1.66	5.72	1.89	5.22	5.66	9.88
Al_2O_3, Fe_2O_3	2.48	3.08	1.57	6.32	4.86	1.46
$CaCO_3$	56.94	80.11	87.88	52.93	52.89	79.39
$MgCO_3$	35.55	8.09	7.43	32.75	33.46	6.20
	96.63	97.00	98.77	97.22	96.87	96.93

	M.	N.	O.	P.	Q.
Insoluble	7.46	18.24	2.66	1.08	3.68
Al_2O_3, Fe_2O_3	4.16	7.28	2.14	.66	8.38
$CaCO_3$	71.96	42.82	53.85	90.72	69.53
$MgCO_3$	14.34	28.11	37.33	6.69	10.98
	97.92	96.45	95.98	99.15	92.27

INDIANA.

A. Buff limestone, Hoosier Stone Company, Bedford.
B. Blue limestone, same locality.
Analyses by F. W. Clarke, record Nos. 306, 307.

	A.	B.
SiO_2	.63	1.69
Fe_2O_3	.39	.49
CaO	54.19	54.18
MgO	.39	.37
P_2O_5	trace	trace
CO_2	44.01	43.08
SO_3	none	none
	99.61	99.81

The following Trenton limestones are all from the natural-gas belt:
C. Union City. Depth, 1,160 feet.
D. Bluffton. Depth, 1,062 to 1,067 feet.
E. Muncie. Depth, 920 feet.
F. Greensburg. Depth, 867 feet.
G. Vernon. Depth, 905 feet.
H. Wabash. Depth, about 900 feet.
Analysis C by F. W. Clarke, record No. 738. The remainder by Charles Catlett, Nos. 753, 758.

	C.	D.	E.	F.	G.	H.
Insoluble	2.14	2.37	3.30	.87	8.00	3.52
$Al_2O_3.Fe_2O_3$	1.23	4.48	3.72	.55	.60	7.58
$CaCO_3$	83.21	53.43	51.96	94.60	85.56	53.18
$MgCO_3$	12.48	37.47	38.11	.36	trace	30.53
	99.06	97.75	97.09	96.38	94.16	94.81

MISSOURI.

Limestones and dolomites collected by W. P. Jenney. Analyses by L. G. Eakins, record Nos. 1184, 1207. CO_2 calculated.

A, B. Cherokee limestone, quarry near Seneca, Newton County.

C, D. The same, near Grand Falls, Newton County.

E, F. Dolomite, Oswego land, Joplin.

	A.	B.	C.	D.	E.	F.
Insoluble	.66	1.21	1.01	1.01	29.77	11.66
Al_2O_3	.11	.13	.08	.13	1.32	1.03
FeO	.05	.07	.05	trace		
MnO	trace	trace	.03	trace	----------	----------
CaO	55.29	54.92	54.98	55.11	21.46	28.72
MgO	.23	.20	.31	.32	14.79	17.26
CO_2	43.69	43.31	43.54	43.65	33.13	41.55
	100.03	99.84	100.00	100.22	100.47	100.22

KANSAS.

A. Limestone, Silverdale. Analysis by Charles Catlett, record No. 967.

B. Cherokee limestone, Short Creek, near Spring River, Cherokee County. Analysis by L. G. Eakins, record No. 1184.

C. Supposed marl, large surface deposit near Wakeeney, Trego County. Analysis by F. W. Clarke, record No. 212.

	A.	B.	C.
Insoluble	----------	.32	----------
SiO_2	5.27	----------	14.06
Al_2O_3	1.07	.17	----------
Fe_2O_3	.71	----------	5.10
FeO	.32	.20	----------
MnO	----------	.02	----------
CaO	50.36	55.25	43.05
MgO	.56	.35	.50
K_2O	.10	----------	----------
Na_2O	.20	----------	----------
H_2O	.78	----------	1.77
P_2O_5	.06	----------	----------
CO_2	40.34	43.79	35.03
SO_2	.07	----------	----------
	99.84	100.10	99.51

MICHIGAN, WISCONSIN, MINNESOTA, CANADA.

Most of the rocks considered under this heading were described by Irving and Van Hise in Mon. XIX, pages 131 and 191. A few other analyses, also representing Van Hise's collections, are taken from the laboratory records. The Canadian rocks are from near the boundary line, and relate directly to others gathered upon the Minnesota side.

A. Dolomite, near Sunday Lake, Gogebic district, Michigan. Analysis by W. F. Hillebrand, record No. 767.

B. Dolomite, Penokee region, Wisconsin, NW. ¼ sec. 22, T. 44 N., R. 5 W. Analysis by Hillebrand, record No. 768.

C. Limestone, bed of Slate Creek, Huron Bay slate quarries, Michigan. Analysis by T. M. Chatard, record No. 894. From laboratory records; not in the monograph cited.

D. Limestone, east end of Ogiskemannissi Lake, Minnesota. Analysis by Chatard, record No. 899. Not in monograph.

	A.	B.	C.	D.
SiO_2	3.07	.63	7.05	41.99
Al_2O_3	....	....	.48	1.24
Fe_2O_3	.09	.03	1.33	.42
FeO	.86	.75	undet.	4.77
MnO	.15	.08	.19	.26
CaO	29.72	30.94	50.08	16.85
MgO	19.95	20.68	.57	8.41
H_2O at 105°	} .30	.27	....	.05
H_2O ign			.25	1.02
P_2O_5	....	....	.27	.05
CO_2	45.31	46.27	39.68	24.70
SO_3	....	....	.21	.32
Cl	trace	trace	....	....
	99.45	99.65	100.11	100.08

E. Iron carbonate, SE. ¼ sec. 20, T. 47 N., R. 43 W., Michigan.

F. Iron carbonate, south side of Sunday Lake, Michigan.

G. Iron carbonate, Palms mine, Gogebic district, Michigan.

Analyses E, F, and G by W. F. Hillebrand, record Nos. 769, 770, 771.

H. Iron carbonate, Miner and Wells Option, sec. 13, T. 47 N., R. 46 W., Michigan. Analysis by T. M. Chatard, record No. 893.

I. Iron carbonate, NW. ¼ sec. 18, T. 47 N., R. 45 W., Michigan. Analysis by Chatard, No. 895.

	E.	F.	G.	H.	I.
SiO_2	3.16	28.86	46.47	46.01	36.73
TiO_2	....	.20	.10	.12	.19
Al_2O_3	.08	1.29	.70	.83	.38
Fe_2O_3	.93	1.01	.86	1.35	.98
FeO	15.18	37.37	28.57	26.07	34.81
MnO	1.15	.97	.40	2.09	.52
CaO	26.65	.74	.49	.63	.48
MgO	11.01	3.64	2.30	2.86	2.74
H_2O at 105°	.54	.68	.60	1.71	.12
H_2O ign					1.40
P_2O_5	.06	trace	trace	.07	.01
CO_2	41.10	25.21	19.24	17.72	22.44
SO_3	....	....	....	.15	.16
Cl	trace	....	?	....	....
FeS_2	.34	....	....	....	....
	100.20	99.97	99.73	99.61	100.96

J. Iron carbonate, Penokee iron range, NE. ¼ sec. 6, T. 45, R. 2 E., Wisconsin. P. R. C. 999.

K, L. Black, slaty, carbonaceous iron carbonates, Animikie formation, Kakabikka Falls, Kaministiquia River, Canada.

M. Iron carbonate, west end of Gunflint Lake, Minnesota.

N. Iron carbonate, north side of Gunflint Lake, Minnesota.

O. Iron carbonate, north side of Gunflint Lake, Canada.

Analyses J, K, and L by R. B. Riggs, record Nos. 376, 377, 378; M, N, and O by T. M. Chatard, record Nos. 897, 898, 900.

	J.	K.	L.	M.	N.	O.
SiO_2	15.62	37.73	54.26	58.23	46.46	23.90
TiO_2	....	....	....	trace ?	trace ?	none
Al_2O_3	4.27	3.41	2.57	.06	.24	.07
Fe_2O_3	8.14	6.42	3.62	5.01	.64	.44
FeO	32.85	22.92	19.63	18.48	26.34	10.72
MnO	5.06	.40	.19	.25	.21	.28
CaO	.81	1.26	1.07	.38	1.87	22.25
MgO	2.66	3.98	2.93	9.59	3.10	8.52
H_2O at 110°	$\left.\right\}$ .68	$\left.\right\}$ 2.74	$\left.\right\}$ 1.20	.07	.07	none
H_2O at redness				2.01	1.15	.99
P_2O_5	....	....	....	.03	.13	trace
CO_2	30.32	18.01	14.93	5.22	19.96	32.42
SO_3	....	....	....	.19	.14	.17
C	....	3.54	.45	....	....	....
	100.41	100.41	100.85	99.52	100.31	99.76

P. Ferrodolomite, Marquette district, Michigan. Analysis by George Steiger, record No. 1473. P. R. C. 994.

Q. Ferrodolomite, Marquette district, Michigan.

R. Portion of Q insoluble in hydrochloric acid.

S. Soluble portion of Q.

Analyses Q, R, and S by George Steiger, record No. 1442. These rocks are not in the monograph cited.

	P.	Q.	R.	S.
SiO_2	42.37	26.97	26.67	.30
Al_2O_3	....	1.30	.12	1.18
Fe_2O_3	1.09	2.31	.16	2.15
FeO	31.41	39.77	....	39.77
MnO	....	.29	....	.29
CaO	.50	.66	....	.66
MgO	2.48	1.94	.10	1.84
Alkalies	....	.09	....	.09
H_2O at 100°	....	.10	....	....
H_2O above 100°	....	.51	....	....
P_2O_5	....	.03	....	.03
CO_2	21.80	26.20	....	26.20
	99.65	100.17	27.05	72.51

YELLOWSTONE NATIONAL PARK.

Travertines described by W. H. Weed in 9th Ann., p. 619.

A. Terrace below the hotel.

B. Cupids Cave.

C. Near Sulphur Spring No. 246, Mammoth Hot Springs.

D. Extinct spring, main terrace, Mammoth Hot Springs.

E. Ridge behind main terrace.

Analysis C by F. A. Gooch, record No. 243; A, B, D, and E by J. E. Whitfield, record Nos. 240, 242, 244, 245.

	A.	B.	C.	D.	E.
SiO_2	.08	.15	.01	.06	.26
Al_2O_3	.15	.49	.05	.14	.11
Fe_2O_3	----------	----------		----------	----------
CaO	53.83	53.41	55.02	55.02	54.06
MgO	.90	.42	.07	.06	.66
K_2O	----------	.01	.04	----------	----------
Na_2O	----------	.03	----------	----------	----------
H_2O	1.43	2.44	1.61	1.06	1.19
NaCl	.02	.13	.12	.20	.26
KCl	----------	----------	----------	.08	----------
SO_3	1.72	.55	.49	.70	1.34
CO_2	41.79	41.96	42.25	42.25	42.14
C (organic)	.21	.37	.11	.24	none
	100.13	99.96	99.77	99.81	100.02

MONTANA.

Rocks collected by A. C. Peale. Analyses by Charles Catlett, record Nos. 890, 905.

A. North of East Gallatin River.
B. West of North Boulder River.
C, D. North of East Gallatin River.
E. Base of Carboniferous, west side of Bridger Range.
F. Middle Carboniferous, north of Gallatin River.
G, H. Upper Carboniferous, north of Gallatin River.

Analyses all partial. A, B, C, D, and H were published by Peale n Bull. 110, pp. 16, 28, and 40.

	A.	B.	C.	D.
Insoluble	.34	1.78	23.50	35.26
$Fe_2O_3Al_2O_3$	.22	.40	2.50	1.92
$CaCO_3$	54.54	54.54	67.85	59.11
$MgCO_3$	43.63	42.62	6.18	1.96
	99.73	99.34	100.03	98.25

	E.	F.	G.	H.
Insoluble	9.98	5.99	50.74	25.24
Fe_2O_3, Al_2O_3	.38	.58	.30	5.30
$CaCO_3$	88.50	91.96	32.28	40.21
$MgCO_3$	.95	1.35	13.91	25.25
	99.81	99.88	97.23	96.00

COLORADO.

1. DENVER BASIN.

Rocks described by Emmons in Mon. XXVII. Analyses made by L. G. Eakins, in the Denver laboratory.

A. Upper Wyoming limestone, Morrison.

B. Niobrara dolomite.

	A.	B.
Insoluble	5.32	12.01
Al_2O_3	.53	.54
Fe_2O_3	.38	.11
MnO	.49	.20
CaO	48.73	27.49
MgO	2.95	18.03
H_2O	.11	.61
P_2O_5	.03	.03
CO_2	41.71	41.40
	100.25	100.42

2. LEADVILLE DISTRICT.

Rocks described by Emmons in Mon. XII. Analyses A and E by W. F. Hillebrand; B, C, and D by A. Guyard; all made in the Denver laboratory.

A. Upper blue limestone, Silver Wave mine.
B. Upper blue limestone, Dugan quarry.
C. Upper blue limestone, Glass-Pendery mine.
D. Montgomery quarry, near base of blue limestone.
E. White limestone, upper part, Carbonate Hill quarry.

	A.	B.	C.	D.	E.
SiO_2	.21	.70	.27	7.76	11.84
Al_2O_3	.27	.17	.04	.11	1.66
Fe_2O_3	.21	.11	.22	.10	1.51
FeO	.24	.38	.13	.57	.83
MnO	trace	.05	.20	.06	....
CaO	30.79	30.43	29.97	27.26	26.60
MgO	21.14	20.78	21.52	20.05	17.41
K_2O	.03	.05	.01	.02	.02
Na_2O	.06	.09	.02	.04	.03
H_2O	.22	.04	.07	.05	.48
P_2O_5	trace	.12	.03	.07	trace
CO_2	46.84	46.93	47.39	43.79	40.01
SO_3	trace	....	....	trace	....
Cl	.10	.14	.04	.06	.05
FeS_2	trace	trace	....	trace	....
Organic matter	.03	.03	.02	.07	....
	100.14	100.02	99.93	100.01	100.44

3. FAIRPLAY, PARK COUNTY.

Analyses made by W. F. Hillebrand, in the Denver laboratory.
A. Serpentinous limestone, Buckskin Gulch.
B. Limestone, Fairplay.
C. Limestone, Mount Silverheels.
D. Dolomite-limestone, Mount Silverheels.
Analyses B, C, and D partial, with CO_2 calculated to satisfy bases.

	A.	B.	C.	D.
Insoluble	....	2.37	.51	1.98
SiO_2	17.64	....	....	....
Al_2O_3	.99	....	....	....
Fe_2O_3	.62	....	....	....
FeO	.18	} .19	} .10	} .46
MnO	trace			
CaO	32.23	53.64	55.50	30.19
MgO	19.01	.73	.17	20.47
Alkalies	.07	....	....	....
H_2O	3.72	.51	....	....
P_2O_5	.05	....	....	....
CO_2	25.33	42.93	43.82	46.52
Cl	.08	....	....	....
	99.92	100.37	100.10	99.62

4. PITKIN COUNTY.

Limestones and dolomites collected under the direction of S. F. Emmons. Analyses by George Steiger, record No. 1559. CO_2 calculated to satisfy bases. Analyses partial only.

	A.	B.	C.	D.	E.	F.	G.
Insoluble	.16	.80	1.02	13.63	1.42	31.12	7.78
Fe_2O_3	.22	1.63	2.10	1.88	3.34	.36	.88
FeO	.09	.23	.06	.64	.42	.19	.22
CaO	30.66	31.19	33.74	35.98	31.61	37.28	38.85
MgO	20.94	19.69	16.76	8.25	18.06	.54	9.97
CO_2	47.13	46.16	44.94	37.35	44.70	29.88	41.47
	99.20	99.70	98.62	97.73	99.55	99.37	99.17

The following samples from Aspen were analyzed by L. G. Eakins in the Denver laboratory. Partial analyses, CO_2 calculated as before.

H. Blue limestone.

I. Limestone.

J. Dolomite.

	H.	I.	J.
Insoluble	.52	.33	.84
Fe_2O_3	.88	trace	1.31
CaO	31.16	55.81	30.46
MgO	20.64	.16	20.90
CO_2	47.19	44.03	46.92
	100.39	100.33	100.43

5. GLENWOOD SPRINGS, GARFIELD COUNTY.

Limestones and dolomites collected under the direction of S. F. Emmons. Analyses, partial only, by George Steiger, record No. 1559. CO_2 calculated to satisfy bases.

	A.	B.	C.	D.	E.	F.	G.
Insoluble	21.45	47.74	6.47	3.71	9.44	17.82	1.96
Fe_2O_3	.97	.18	.42	none	.26	.74	.03
FeO	.23	.71	.35	.55	.32	.57	.35
CaO	40.64	15.87	46.65	47.40	39.56	26.50	32.14
MgO	.73	10.60	2.64	4.49	8.56	14.86	18.72
CO_2	32.73	24.13	39.55	42.15	40.52	37.18	45.85
	96.75	99.23	96.08	98.30	98.66	97.67	99.05

	H.	I.	J.	K.	L.	M.
Insoluble	2.27	.22	.23	.06	.22	.11
Fe_2O_3	.14	trace	.09	none	.10	.03
FeO				none	.10	.07
CaO	53.79	55.17	55.49	55.81	55.45	55.68
MgO	.46	.21	.24	trace	.24	trace
CO_2	42.76	43.58	43.87	43.85	43.84	43.75
	99.42	99.18	99.92	99.72	99.95	99.64

6. TENMILE DISTRICT, SUMMIT COUNTY.

Partial analyses, made in the Denver laboratory, by W. F. Hillebranc CO_2 calculated to satisfy bases. Manganese and iron present as ca bonates, but Fe_2O_3 and Al_2O_3 were not separated from them.

A. A. V. Fletcher shaft, Copper Mountain.
B. Pittston tunnel.
C. Middle Carboniferous, Pearl Hill.
D. Summit quarry.
E. Dolomite, Sheep Mountain.
F. Oolitic limestone, northwest corner of area.
G. Pittston tunnel.

	A.	B.	C.	D.	E.	F.	G.
Insoluble	2.69	.62	10.09	1.75	.78	1.37	7.91
FeO, MnO	.21	.25	1.19	.32	1.50	.20	.32
CaO	54.23	55.24	28.01	53.60	30.55	55.17	50.83
MgO	.21	.24	18.33	1.23	20.15	.28	.70
CO_2	42.97	43.81	42.63	43.65	47.04	43.76	40.90
	100.31	100.16	100.25	100.55	100.02	100.78	100.66

H. Dolomite, Blackbird tunnel, Tucker Mountain.
I. Summit King shaft, Summit City.
J. Middle Carboniferous dolomite, Ptarmigan Hill.
K. Hill north of Sugar Loaf.
L. Quarry on southeast side of Searls Gulch.
M. Open cut below Sabbath Rest tunnel, Elk Mountain.
N. Triassic, Jacque Mountain.

	H.	I.	J.	K.	L.	M.	N.
Insoluble	2.68	6.75	.65	4.42	.36	.82	2.04
FeO, MnO	1.52	3.08	1.67	.10	.17	.07	.15
CaO	31.60	28.05	30.90	52.97	55.58	55.47	54.62
MgO	18.27	18.15	19.75	.40	.37	.22	.25
CO_2	45.75	43.88	47.02	42.12	44.17	43.86	43.28
	99.82	99.91	99.99	100.01	100.65	100.44	100.34

UTAH.

A. Marble from the Ontario mine, east end of the 1,000-foot level. Analysis made by L. G. Eakins, in the Denver laboratory.

B. Oolitic sand from shore of Great Salt Lake. Analysis by T. M. Chatard, record No. 156.

	A.	B.
Insoluble in HCl	9.61	4.03
Al_2O_3	trace	.20
Fe_2O_3		
CaO	50.63	51.33
MgO	.09	.72
Alkalies		.63
CO_2	*a* 39.89	41.07
P_2O_5		trace
SO_3		.89
H_2O		.83
Organic matter		.27
	100.22	99.97

a Calculated to satisfy bases.

NEVADA AND CALIFORNIA.

A. Crystalline limestone, Eureka, Nevada. Analysis by E. A Schneider, record No. 1279.

B. From base of the Hamburg limestone, Eureka district, Nevada

C. From summit of Hamburg limestone, Eureka.

D. Pogonip limestone (Silurian), Eureka district. Analyses B, C and D made by W. F. Hillebrand in the Denver laboratory. Described by Hague in Mon. XX, pp. 40, 49. In D the CO_2 was taken by difference.

E. Cretaceous limestone from Mount Diablo, California. Analysis made by W. H. Melville in the San Francisco laboratory and published in Bull. Geol. Soc. Amer., vol. 2, p. 409. FeO and alkalies undetermined.

F. White deposit, White Terrace, west shore of Pyramid Lake, Nevada. Analysis by T. M. Chatard, record No. 34.

	A.	B.	C.	D.	E.	F.
Insoluble	.53	....	....	....	....	....
SiO_2	....	24.00	3.94	9.34	21.19	22.00
Al_2O_3	....	.12	.64	.31	.39	5.14
Fe_2O_3	....	.12	.43	.29	1.52	2.04
FeO	....	....	.20	....	....	....
MnO	....	....	.61	....	3.61	....
CaO	30.60	41.97	51.96	50.01	35.61	37.22
MgO	21.69	.80	.52	.54	1.39	1.89
Alkalies	....	traces	traces	traces	....	....
H_2O at 100°	....	.16	.37	.13	.76	3.32
H_2O above 100°	....				2.33	
P_2O_5	....	.07	.50	.24	2.55	....
CO_2	47.13	32.62	40.71	39.11	26.84	28.53
Organic matter	....	traces	.03	traces	....	....
Cl	....	.01	.01	.03	....	....
	99.95	99.87	99.92	100.00	96.19	100.14

HAWAIIAN ISLANDS.

Coral and shell rocks, analyzed for N. S. Shaler by L. G. Eakins, record Nos. 886, 887, 889. Analyses only partial.

A. Laie.
B, C. Kohuku Bluff.
D. Kohuku coral flat.
E. Point near coral flat.
F. "Modern chalk," Oahu.
G. Diamond Head.
H. Under lava, Honolulu.
I. Old reef, Waialua.
J. Campbell's ranch, Waianea, Oahu.
K. Wailuku Bay.
L. Reef No. 3, Honolulu.
M. Prison Knoll, Honolulu.

	A.	B.	C.	D.	E.	F.	G.
SiO_2	.35	.19	.67	.25	.26	33.25	2.97
Al_2O_3	.19	.52	.73	.49	.21	19.53	2.88
Fe_2O_3						10.71	
CaO	49.38	49.34	51.09	53.34	52.17	11.37	44.82
MgO	1.74	4.60	2.50	.67	1.51	3.06	5.32
CO_2	41.89	44.33	43.64	43.89	43.95	11.09	40.81
H_2O	4.74	.40	.79	.93	.70	9.84	1.86
	98.29	99.38	99.42	99.57	98.80	98.85	98.66

	H.	I.	J.	K.	L.	M.
SiO_2	5.34	1.05	.53	.45	3.53	.81
Al_2O_3	5.11	1.26	.62	1.82	2.26	1.19
Fe_2O_3						
CaO	42.24	51.07	50.69	50.54	46.52	52.67
MgO	5.95	.11	2.98	1.83	2.45	.42
CO_2	38.71	42.68	43.96	42.80	40.59	42.81
H_2O	1.61	1.33	.46	1.93	2.75	1.24
	98.96	97.50	99.24	99.37	98.10	99.14

SLATES AND SHALES.

VERMONT.

Samples A to I, inclusive, are described by T. Nelson Dale in 19th Ann., Part III. Analyses by W. F. Hillebrand, record Nos. 1567, 1656. Roofing slates of Cambrian age.

A. McCarty quarry, South Poultney.
B. Unfading green, Eureka quarry, Poultney.
C. Sea green, Griffith and Nathaniel quarry, South Poultney.
D. Sea green, Rising and Nelson's quarry, Pawlet.
E. Sea green, Brownell quarry, Pawlet.
F. Black, American Black Slate Company, Benson.

	A.	B.	C.	D.	E.	F.
SiO_2	61.63	59.27	62.37	67.76	59.84	59.70
Al_2O_3	16.33	18.81	15.43	14.12	15.02	16.98
Fe_2O_3	4.10	1.12	1.34	.81	1.23	.52
FeO	2.71	6.58	5.34	4.71	4.73	4.88
MgO	2.92	2.21	3.14	2.38	3.41	3.23
CaO	.50	.42	.77	.63	2.20	1.27
Na_2O	1.26	1.88	1.14	1.39	1.12	1.35
K_2O	5.54	3.75	4.20	3.52	4.48	3.77
H_2O at 100°	.31	.32	.34	.23	.41	.30
H_2O above 100°	3.24	3.98	3.71	2.98	3.44	3.82
TiO_2	.68	.99	.74	.71	.74	.79
P_2O_5	.16	.11	.06	.07	.09	.16
MnO	.09	.13	.22	.10	.34	.16
BaO	.06	.05	.07	.04	.09	.08
CO_2	.41	.21	.87	.40	2.98	1.40
FeS_2	.04	.15	.06	.22	.05	1.18
C	none	none	trace	none	trace?	.46
	99.98	99.98	99.80	100.07	100.17	100.05

All six contain traces of lithia, of sulphates, and of nickel or cobalt.

G. Unfading green, Valley Slate Company's quarry, Poultney.
H. Mottled, purple and green, Eureka quarry, Poultney.
I. Purple, 1 mile south of Hydeville, in Castleton.

	G.	H.	I.
SiO_2	59.48	60.24	60.96
Al_2O_3	18.22	18.46	16.15
Fe_2O_3	1.24	2.56	5.16
FeO	6.81	5.18	2.54
MgO	2.50	2.33	3.06
CaO	.56	.33	.71
Na_2O	1.55	1.57	1.50
K_2O	3.81	4.09	5.01
H_2O at 110°	.17	.18	.17
H_2O above 110°	4.05	3.81	3.08
TiO_2	1.02	.92	.86
P_2O_5	.10	.11	.23
MnO	.07	.07	.07
BaO	.05	.03	.04
CO_2	.39	.08	.68
FeS_2	.13	.16	none
F	.08	undet.	undet.
N, as NH_3	.03	.03	.01
	100.26	100.15	100.23

All three contain traces of lithia, nickel, and chlorine, and possibly of zirconia; in G and H traces of strontia, but none in I.

J. Slate from Guilford, collected for the Educational Series of Rock Specimens. Analysis by L. G. Eakins, record No. 1316.

K. Slate from the Lakeshore quarry, Hydeville. Analysis by Eakins, record No. 1159.

	J.	K.
SiO_2	60.72	58.15
Al_2O_3	22.59	18.93
Fe_2O_3	....	2.91
FeO	6.03	5.64
MgO	2.05	2.70
CaO	.41	.60
Na_2O	.86	1.17
K_2O	3.69	3.92
H_2O	3.01	4.56
TiO_2	....	.93
P_2O_5	.13	.12
MnO	trace	.07
SO_3	....	.16
C	.57	....
	100.06	99.86

NEW YORK.

Roofing slates from Washington County, collected by T. Nelson Dale. Of Cambrian age. Described by Dale in 19th Ann., Part III.

A. Red, three-fourths mile south of Hampton Village.

B. Empire Red Slate Company, near Granville.

C. National Red Slate Company, Granville.

D. Green, three-fourths mile northwest of Janesville.

Analyses by W. F. Hillebrand, record No. 1567.

	A.	B.	C.	D.
SiO_2	67.61	67.55	56.49	67.89
Al_2O_3	13.20	12.59	11.59	11.03
Fe_2O_3	5.36	5.61	3.48	1.47
FeO	1.20	1.24	1.42	3.81
MgO	3.20	3.27	6.43	4.57
CaO	.11	.26	5.11	1.43
Na_2O	.67	.61	.52	.77
K_2O	4.45	4.13	3.77	2.82
H_2O at 110°	.45	.40	.37	.36
H_2O above 110°	2.97	3.03	2.82	3.21
TiO_2	.56	.58	.48	.49
P_2O_5	.05	.10	.09	.10
MnO	.10	.19	.30	.16
BaO	.04	.31	.06	.04
CO_2	none	.11	7.42	1.89
FeS_2	.03	.04	.03	.04
	100.00	100.02	100.38	100.08

All contain traces of lithia, of sulphates, and of nickel or cobalt. No carbonaceous matter is present.

E. Red slate, from quarry 3 miles north of Raceville.
F. Green spot in E.
G. Purple rim of green spot F.
Analyses by W. F. Hillebrand, record No. 1656.

	E.	F.	G.
SiO_2	63.88	65.44	64.59
Al_2O_3	9.77	9.38	10.23
Fe_2O_3	3.86	1.09	1.79
FeO	1.44	1.06	1.19
MgO	5.37	4.92	5.12
CaO	3.53	4.53	4.07
Na_2O	.20	.22	.23
K_2O	3.45	3.57	3.70
H_2O at 110°	.27	.25	.28
H_2O above 110°	2.48	2.10	2.29
TiO_2	.47	.52	.51
P_2O_5	.08	.08	.08
MnO	.21	.32	.26
BaO	.05	.06	.05
CO_2	5.08	6.55	5.84
FeS_2	trace	.04	trace
	100.14	100.13	100.23

Contain traces of lithia and nickel. Fluorine not determined.

KENTUCKY, GEORGIA, ALABAMA.

A. Indurated Carboniferous shale, in contact with the peridotite dike of Elliott County, Kentucky. Described by Diller in Bull. 38. Analysis by T. M. Chatard, record No. 351.

B. Fragment of shale included in the Elliott County dike. Analysis by Chatard, record No. 353.

C. Bituminous shale, Dry Gap, Georgia. Analysis by L. G. Eakins, record No. 1316. P. R. C. 22. Described by Diller in Bull. 150, p. 90.

D. Middle Cambrian shale, Coosa Valley, near Blaine, Cherokee County, Alabama. Analysis by H. N. Stokes, record No. 1549.

	A.	B.	C.	D.
SiO_2	41.32	35.53	51.03	55.02
Al_2O_3	20.71	18.23	13.47	21.02
Fe_2O_3	2.59	2.46	8.06	5.00
FeO	5.46	4.81	....	1.54
MgO	1.91	2.01	1.15	2.32
CaO	9.91	21.17	.78	1.60
Na_2O	7.19	2.53	.41	.81
K_2O	.88	1.08	3.16	3.19
H_2O at 110°	....	1.40	.81	2.44
H_2O above 110°	8.78	9.00		5.65
TiO_2	.48	.95	....	.65
P_2O_5	.08	.08	.31	.06
MnO	.17	.13	....	trace
BaO	....	....	....	.04
SrO	....	....	....	trace
Li_2O	....	....	....	.03
SO_3	....	....	....	.02
S	....	....	7.29	....
Cl	....	....	....	trace
CO_2	.55	.88	....	.83
Carbonaceous matter	....	....	....	.32
Fixed carbon	....	....	13.11	....
Volatile hydrocarbons	....	....	3.32	....
	100.03	100.26	102.90	100.54
Less O = S	....	....	2.74	
			100.16	

OHIO.

Three samples of Utica shale from New Vienna. Collected by Edward Orton. Partial analyses by F. W. Clarke and R. B. Riggs, record No. 731.

	A.	B.	C.
Insoluble	60.17	29.51	25.80
CaO	17.11	33.43	35.27
MgO	1.25	2.16	1.32
CO_2	15.24	27.16	27.40
	93.77	92.26	89.79

Iron and alumina are present in the soluble portions of these shales, the solvent being dilute hydrochloric acid.

MICHIGAN.

Clay slate, sec. 17, T. 43 N., R. 31 W., near Mansfield. Contains principally quartz, white mica, actinolite, rutile, hematite, and carbonaceous matter. Described by J. M. Clements in Mon. XXXVI, pp. 59, 61, 210. Analysis by George Steiger, record No. 1709.

SiO_2	60.28
Al_2O_3	22.61
Fe_2O_3	2.53
FeO	.45
MgO	1.35
CaO	.13
Na_2O	.54
K_2O	5.73
H_2O at 100°	.60
H_2O above 100°	3.62
TiO_2	.69
P_2O_5	.03
MnO	trace
BaO	.04
C	.97
	99.57

WISCONSIN.

Slates of the Penokee-Gogebic series, collected by C. R. Van Hise. A and C are described in Mon. XIX, p. 306, as magnetitic clay slates. Analyses by L. G. Eakins, record No. 392.

A. Sec. 6, T. 45 N., R. 2 E.
B. Sec. 1, T. 45 N., R. 1 E.
C. Sec. 4, T. 44 N., R. 2 W.

	A.	B.	C.
SiO_2	53.44	59.73	52.58
Al_2O_3	19.62	22.78	20.76
Fe_2O_3	11.38	.11	12.17
FeO	5.35	5.98	4.08
MgO	1.58	2.94	1.33
CaO	.42	.53	.30
Na_2O	2.61	1.41	.37
K_2O	1.73	3.48	4.87
H_2O	4.07	3.28	3.43
P_2O_5	trace	....	....
MnO	trace	.09	.21
Li_2O	trace	....	trace
	100.20	100.33	100.10

COLORADO.

Shales from the Pueblo quadrangle, collected by G. K. Gilbert.
A, B. Near Nushbaum Spring.
C. Salt Creek.
D. Head of Rock Creek.
E. Near Rush Creek.
Analyses by George Steiger, record No. 1466.

	A.	B.	C.	D.	E.
SiO_2	60.80	51.69	60.60	63.60	45.89
Al_2O_3	15.63	16.50	16.42	16.74	13.24
Fe_2O_3	4.62	7.90	4.95	4.63	3.88
MgO	2.73	2.10	1.43	1.19	2.12
CaO	1.63	4.41	1.61	.68	12.09
Na_2O	1.45	2.07	.92	.29	.47
K_2O	2.55	2.68	2.98	2.92	2.31
H_2O at 100°	3.19	3.02	3.91	2.88	1.38
H_2O above 100°	4.16	6.00	5.72	5.99	4.16
TiO_2	.47	.66	.35	.66	.52
P_2O_5	.10	.22	.31	.16	.17
CO_2	....	3.19	....	....	10.38
Organic matter	2.87	.53	.84	.46	3.47
	100.20	100.97	100.04	100.20	100.08

Calcareous shales from Fairplay, Park County. Partial analyses, by W. F. Hillebrand, made in the Denver laboratory.

	F.	G.
Insoluble	68.72	35.14
Fe_2O_3, Al_2O_3, etc	2.10	....
FeO, MnO	....	2.10
MgO	5.72	12.55
CaO	9.06	19.34
H_2O	1.01	.73
CO_2, calculated	13.41	30.28
	100.02	100.14

CALIFORNIA.

Cretaceous shales from Mount Diablo. Described by Turner and Melville, Bull. Geol, Soc. Amer., vol. 3, pp. 383–414. Anlayses by W. H. Melville, made in the laboratory at San Francisco, except F (record No. 1166), which was done in the Washington laboratory.

A. Brownish black, resinous. From Bagley Canyon.

B. Slate colored, soft, friable, little altered. From near Bagley Creek.

C. Same locality as B, less friable, but considerably altered.

D. Slate colored, friable. From Arroyo del Cerro.

E. Very friable. Same locality as D.

	A.	B.	C.	D.	E.
SiO_2	56.66	53.65	49.14	25.05	40.17
Al_2O_3	17.64	17.64	16.91	8.28	12.76
Fe_2O_3	.49	4.06	4.39	.27	2.10
FeO	5.22	3.72	3.82	2.41	3.56
MgO	3.50	5.15	5.43	2.61	15.42
CaO	1.67	2.27	3.28	27.87	4.24
Na_2O	2.17	2.53	4.67	undet.	.57
K_2O	2.27	2.22	1.53	undet.	1.36
H_2O at 100°	3.01	3.95	3.39	1.44	9.19
H_2O above 100°	5.92	4.57	6.97	2.86	6.73
P_2O_5	.15	.23	.24	.08	.08
NiO	....	trace	trace	trace	trace
MnO	.19	.01	.22	4.11	.16
CO_2	....	....	....	24.20	3.48
SO_3	.93	....	....	....	....
	99.82	100.00	99.99	99.18	99.82

F. Neocomian shale, altered, light brown, friable. From near Arroyo del Cerro.

G. Calcareous shale, near Arroyo del Cerro. Hard, compact, dark colored. Very much altered.

H. Red shale, metamorphic area at head of Bagley Creek.

I. Silicified shale or phthanite, same locality as H.

J. Clay slate, near the head of Yaqui Gulch, in Mariposa County. Described by Turner in Bull. 150, p. 342. Contains grains of quartz and feldspar, abundant carbonaceous particles, a chloritic substance (?), and a fibrous alteration of sillimanite (?). Analysis by George Steiger, record No. 1643.

	F.	G.	H.	I.	J.
SiO_2	45.64	44.56	69.98	93.54	60.35
Al_2O_3	15.42	3.12	11.69	2.26	17.62
Fe_2O_3	3.40	1.27	6.23	.48	5.64
FeO	3.73	5.21	1.08	.79	2.20
MgO	4.62	3.39	1.29	.66	1.04
CaO	8.11	12.70	.38	.09	.45
Na_2O	3.13	3.09	.73	.37	1.00
K_2O	1.86	.88	3.72	.51	3.16
H_2O at 100°	8.74	1.41	1.03	.21	1.02
H_2O above 100°		6.24	2.92	.72	4.36
TiO_2	....	....	....	....	.75
P_2O_5	.27	.16	.05	....	.17
Cr_2O_3	.12	....	....	....	....
MnO	.33	trace	.49	.23	none
BaO	....	....	....	....	.12
CO_2	4.59	17.62	....	....	none
SO_3	....	....	....	....	.05
Cl	....	....	....	....	.01
F	....	....	....	....	trace
C	....	....	....	....	1.72
	99.96	99.65	99.59	99.86	99.76

CLAYS, SOILS, ETC.

MASSACHUSETTS.

Clays and soils from Marthas Vineyard, collected by N. S. Shaler. See 7th Ann., p. 303. Analyses by F. W. Clarke, record Nos. 439, 440, 441, 442, 443, 444, 445, 446, 454, and 455. Partial analyses only.

A. Average sample of white clay, east end of Chilmark Cliffs.

B. Average sample of clays, Weyquosque series, Chilmark Cliffs.

C. Average sample of fine clay and soil, east end of Weyquosque Cliffs.

D. Sandy white clay, south end of Gay Head Cliffs.

E. Average sample of fine white clay, south end of Gay Head Cliffs.

	A.	B.	C.	D.	E.
SiO_2	82.95	61.76	70.81	56.19	73.46
Al_2O_3. Fe_2O_3	13.45	25.35	20.67	30.65	19.06
MgO	trace	1.95	1.99	trace	trace
CaO	none	.51	trace	none	none
Na_2O	......	1.83	1.23	......	.70
K_2O	......	3.01	1.67	......	.73
Ignition	3.47	5.76	3.39	10.79	6.36
P_2O_5	none	trace	none	none	none
SO_3	......	......	......	2.45	none
	99.87	100.17	99.76	100.08	100.31

F. Average sample of clay, north end of Gay Head Cliffs.

G. Average sample of southernmost red clays, Gay Head.

H. Brown clay, south of light-house, Gay Head Cliffs.

I. Average sample of red clay from the greensand, north end of Gay Head.

J. Pyritiferous clay, central part of Gay Head section.

	F.	G.	H.	I.	J.
SiO_2	49.19	57.50	56.62	55.93	72.74
Al_2O_3, Fe_2O_3	39.77	31.21	31.24	33.51	21.46
MgO	trace	.20	1.97	.19	trace
CaO	none	.19	trace	none	none
Na_2O	......	}	.40	undet.	......
K_2O	......	} .40	2.76	undet.	......
Ignition	11.47	9.83	7.57	9.98	5.69
P_2O_5	none	none	none	none	none
	100.43	99.33	100.56	99.61	99.89

NEW YORK, PENNSYLVANIA, DELAWARE.

A. Clay, near Richfield Springs, New York. Partial analysis by Charles Catlett, record No. 946.

B, C. Clays, Northumberland County, Pennsylvania. Analyses by Charles Catlett, record No. 952.

D. Kaolin, Hockessin, Delaware. P. R. C. 149.

E. Portion of D insoluble in sulphuric acid.

F. Portion of D soluble in sulphuric acid.

Analyses D, E, and F by George Steiger, record No. 1626.

	A.	B.	C.	D.	E.	F.
SiO_2	49.65	65.97	59.16	48.73	29.55	19.18
Al_2O_3	23.82	20.37	18.68	37.02	18.44	18.58
Fe_2O_3		2.75	10.32	.79	.27	.52
MgO	trace	.52	.67	.11	trace	.11
CaO	6.48	.64	.52	.16	.02	.14
Na_2O	undet.	.05	.11	.04	.02	.02
K_2O	undet.	3.32	3.35	.41	.41	none
H_2O at 100°	16.18	6.28	6.87	.52	....	....
H_2O above 100°				12.83	6.84	5.99
TiO_2	....	....	....	.17	.11	.06
P_2O_5	....	....	....	.03	undet.	undet.
	96.13	99.90	99.68	100.81	55.66	44.60

MARYLAND.

Clays from the Matawan formation, received from W. B. Clark. Analyses by George Steiger, record No. 1684.

A. Below Barnard's wharf, near Betterton, Kent County.
B. Severn River, below Round Bay, Anne Arundel County.
C. Magothy River near Wilson's wharf, Anne Arundel County.
D. Fort Washington Bluff.

	A.	B.	C.	D.
SiO_2	73.47	87.15	82.86	73.02
Al_2O_3 *a*	12.69	6.46	6.49	10.00
Fe_2O_3	4.62	2.15	3.54	4.78
MgO	.59	.27	.52	.90
CaO	.15	.10	.29	.57
Na_2O	.09	.14	.16	.59
K_2O	1.55	.90	1.16	1.92
H_2O at 100°	.89	.32	.69	1.09
H_2O above 100°	3.85	1.90	2.24	3.07
SO_3	.19	none	.21	1.04
	98.09	99.39	98.16	96.98

a Titanic and phosphoric oxides not separated.

No carbonates present. Sulphides undetermined.

VIRGINIA, NORTH CAROLINA.

A. Residual clay from decay of Trenton limestone, Lexington, Virginia. Described by Russell in Bull. 52. Analysis by R. B. Riggs, record No. 373. See also analysis of the limestone.

B. Residual clay from limestone, Staunton, Virginia.

C. Portion of B soluble in weak hydrochloric acid.

D. Insoluble portion of B. Analyses B, C, and D by George Steiger, record No. 1630. See also analysis of limestone.

E. Decomposed dolerite, near Wadesboro, North Carolina. Described by Russell in Bull. 52. Analysis by T. M. Chatard, record No. 327.

F. Residual clay from decay of chloritic schist, Cary, 8 miles west of Raleigh, North Carolina. Analysis by R. B. Riggs, record No. 364. Described by Russell in Bull. 52.

	A.	B.	C.	D.	E.	F.
SiO_2	43.07	55.90	3.09	52.81	39.55	54.54
Al_2O_3	25.07	19.92	3.96	15.96	28.76	26.43
Fe_2O_3	15.16	7.30	6.25	1.05	16.80	9.04
FeO	....	.39	.30	.09	....	....
MgO	.03	1.18	.43	.75	.59	....
CaO	.63	.50	.30	.20	.37	....
Na_2O	1.20	.23	.20	.03	undet.	....
K_2O	2.50	4.79	.28	4.51	undet.	....
H_2O at 110°	} 12.98	2.54	....	....	} 13.26	} 9.87
H_2O above 110°		6.52	2.10	4.42		
TiO_2	....	.20	.04	.16	.64	....
P_2O_5	....	.10	.04	.06	.10	....
Cr_2O_3	....	....	....	....	trace	....
MnO	....	none	....	....	trace	....
CO_2	....	.38	.38	none	....	....
	100.64	99.95	17.37	80.04	100.07	99.88

SOUTH CAROLINA, GEORGIA.

A, B, C. Clays, near Augusta, Georgia. Partial analyses by George Steiger, record No. 1395.

D. Kaolin, Aiken, South Carolina. Analysis by Steiger, No. 1472.

	A.	B.	C.	D.
SiO_2	60.24	61.36	60.70	44.94
Al_2O_3	26.72	29.04	29.24	39.18
Fe_2O_3				.52
MgO	present	present	present	----------
CaO	.88	.76	.68	----------
Alkalies	undet.	undet.	undet.	----------
H_2O at 100°				.47
H_2O at 200°	6.28	7.46	6.74	.20
H_2O at 300°				.27
H_2O, ignition				13.38
TiO_2	----------	----------	----------	.65
P_2O_5	----------	----------	----------	.12
	94.12	98.62	97.36	99.73

FLORIDA.

A. Hammock clay, Melborne Creek. Collected by N. S. Shaler. Partial analysis by L. G. Eakins, record No. 881.

B. Clay, Tampa.

C. Clay, Lakeland.

B and C collected by W. H. Dall. Analyses by L. G. Eakins, record No. 1255, partial.

	A.	B.	C.
SiO_2	38.04	70.78	80.39
Al_2O_3, Fe_2O_3	27.19	11.33	15.03
MgO	.46	----------	----------
CaO	10.73	2.18	1.22
H_2O	*a* 23.61	14.55	4.34
	100.03	98.84	100.98

a Includes some CO_2.

Clays collected by G. H. Eldridge.

D, E. From the Sandlin place, 2 miles southeast of Marion, Hamilton County.

F. From Richmond's, 6 miles south of Leesburg, Lake County.

G, H. From Bartow Junction.

Analyses D, E, and F by H. N. Stokes, record No. 1493; G and H by George Steiger, No. 1545.

	D.	E.	F.	G.	H.
SiO_2	15.68	78.23	84.41	79.99	79.48
Al_2O_3	.61	7.30	11.02	10.82	12.14
Fe_2O_3	.45	1.85	trace	3.25	2.64
FeO	....	....	....	.25	.09
MgO	17.28	2.11	trace	.07	.07
CaO	26.11	1.60	.20	.23	.31
H_2O at 100°	} 1.97	} *a* 8.48	} *a* 4.25	.90	.86
H_2O above 100°				4.09	4.73
P_2O_5	trace	trace	trace	....	....
CO_2	37.90	....	....	none	none
	100.00	99.57	99.88	99.87	100.32

a Includes a little CO_2.

I. "Filtering clay," Ocala. Received from D. T. Day. Analysis by H. N. Stokes, record No. 1738.

SiO_2	36.73
Al_2O_3	27.78
Fe_2O_3	3.21
MgO	.64
CaO	.81
Na_2O	none
K_2O	.42
H_2O at 110°	7.38
H_2O above 110°	12.14
TiO_2	1.27
P_2O_5	5.54
CO_2	none
Organic matter	3.61
	99.53

ALABAMA, MISSISSIPPI.

A. Kaolin, Greenville, Alabama. Contains about 40 per cent of kaolin, with fragments of quartz, feldspar, and mica. Analysis by T. M. Chatard, record No. 1148.

B. Residual clay from decay of Knox dolomite, Morrisville, Alabama. Described by Russell in Bull. 52. Analysis by W. F. Hillebrand, record No. 797. See also analysis of the dolomite.

C. Loess from Vicksburg, Mississippi. Described by Chamberlin and Salisbury, 6th Ann., p. 282. Analysis by R. B. Riggs, record No. 294.

	A.	B.	C.
SiO_2	69.84	55.42	60.69
Al_2O_3	19.91	22.17	7.95
Fe_2O_3	.90	8.30	2.61
FeO	----------	trace	.67
MgO	.28	1.45	4.56
CaO	.07	.15	8.96
Na_2O	.21	.17	1.17
K_2O	2.14	2.32	1.08
H_2O at 110°	.06	2.10	----------
H_2O, ign	6.72	7.76	1.14
TiO_2	----------	----------	.52
P_2O_5	----------	----------	.13
MnO	trace	----------	.12
CO_2	----------	----------	9.63
C, organic	----------	----------	.19
SO_3	----------	----------	.12
Cl	----------	----------	.08
	100.13	99.84	99.62

ILLINOIS, IOWA, MINNESOTA.

A, B. Clays from Henry County, Illinois. Analyses by T. M. Chatard, record No. 144.

C. Loess, a stratum overlying residuary clay, 350 feet above the Mississippi River, near Galena, Illinois. Described by Chamberlin and Salisbury, 6th Ann., p. 282. Analysis by R. B. Riggs, record No. 293. Dried at 100°.

D. Loess, 300 feet above the Mississippi, 3½ miles northwest of Dubuque, Iowa. Described by Chamberlin and Salisbury (*l. c.*), and analyzed by Riggs, No. 292. Dried at 100°.

E. Tallow clay, lead mine at Lansing, Iowa. Collected by W. P. Jenney. Analysis by H. N. Stokes, record No. 1337. Dried at 100°. Partial analysis.

F. Greenish-gray clay, New Ulm, Minnesota. Analysis by T. M. Chatard, record No. 825.

	A.	B.	C.	D.	E.	F.
SiO_2	46.12	42.58	64.61	72.68	52.08	61.32
Al_2O_3	15.24	12.16	10.64	12.03	23.11	12.27
Fe_2O_3	4.41	3.90	2.61	3.53	9.34	3.62
FeO			.51	.96		4.18
MgO	3.63	4.32	3.69	1.11	2.12	1.76
CaO	8.63	11.33	5.41	1.59	1.04	.99
Na_2O	1.54	1.96	1.35	1.68	undet.	42
K_2O	3.79	3.88	2.06	2.13	undet.	3.59
H_2O	15.57	18.64	2.05	2.50	9.80	10.73
TiO_2	.79	.64	.40	.72		.66
P_2O_5	.08	.10	.06	.23		.27
MnO	.28	.09	.05	.06		.27
ZnO					trace	
PbO					trace	
BaO						.05
CO_2			6.31	.39		
C, organic			.13	.09		
SO_3			.11	.51		.19
Cl			.07	.01		
	100.08	99.60	100.06	100.22	97.49	100.32

WISCONSIN.

Clays, etc., described by Chamberlin and Salisbury in 6th Ann., pp. 250 and 282. Analyses by R. B. Riggs, record Nos. 259, 260, 261, 262, 290, 295. Dried at 100°.

A. Residuary clay from Dodgeville, 4½ feet below surface.
B. The same, 8½ feet below surface.
C. Residuary clay from near Cobb, 4½ feet below surface.
D. Same as C, 3½ feet below surface.
E. Red, putty-like clay, containing pebbles, Milwaukee.
F. Red pebble clay, Milwaukee.

	A.	B.	C.	D.	E.	F.
SiO_2	71.13	49.59	49.13	53.09	40.22	48.81
Al_2O_3	12.50	18.64	20.08	21.43	8.47	7.54
Fe_2O_3	5.52	17.19	11.04	8.53	2.83	2.53
FeO	.45	.27	.93	.86	.48	.65
MgO	.38	.73	1.92	1.43	7.80	7.05
CaO	.85	.93	1.22	.95	15.65	11.83
Na_2O	2.19	.80	1.33	1.45	.84	.92
K_2O	1.61	.93	1.60	.83	2.36	2.60
H_2O	4.63	10.46	11.72	10.79	1.95	2.02
TiO_2	.45	.28	.13	.16	.35	.45
P_2O_5	.02	.03	.04	.03	.05	.13
MnO	.04	.01	.06	.03	trace	.03
CO_2	.43	.30	.39	.29	18.76	15.47
C, organic	.19	.34	1.09	.22	.32	.38
SO_3	....	....	....	....	.13	.05
Cl	....	....	....	....	.06	.04
	100.39	100.50	100.68	100.09	100.27	100.50

MISSOURI, ARKANSAS.

A. Typical loess, Kansas City, Missouri. Dried at 100°. Described by Chamberlin and Salisbury, 6th Ann., p. 282. Analysis by R. B. Riggs, record No. 291.

B, C, D, E. Tallow clays, Joplin, Missouri. Collected by W. P. Jenney. Analyses by T. M. Chatard, record No. 1210.

F. Tallow clay, Aurora, Missouri. Collected by Jenney. Analysis by Chatard, No. 1210. In analyses B, C, D, E, and F the percentages of bases relate to the portion soluble in hydrochloric acid. Analyses only partial.

	A.	B.	C.	D.	E.	F.
Insoluble		40.64	43.07	39.34	39.62	34.04
SiO_2	74.46					
Al_2O_3	12.26	5.72	7.60	6.17	6.45	10.01
Fe_2O_3	3.25	1.30	1.12	1.16	1.53	3.62
FeO	.12					
MgO	1.12	.27	.32	.27	.30	.25
CaO	1.69	1.80	1.70	2.13	1.77	2.09
Na_2O	1.43					
K_2O	1.83					
H_2O	2.70	17.19	16.74	17.63	16.95	16.96
TiO_2	.14					
P_2O_5	.09					
MnO	.02					
ZnO		32.46	29.43	34.28	33.55	33.49
CO_2	.49					
C, organic	.12					
SO_3	.06					
Cl	.05					
	99.83	99.38	99.98	100.98	100.17	100.46

The following partial analyses by H. N. Stokes, record No. 1260, all relate to tallow clays collected by W. P. Jenney. The same remarks apply as to B, C, D, E, and F.

G. Cave Springs mine, Jasper County, Missouri.

H. Great Western mine, Granby, Missouri.

I, J, K. Woodcock mine, Granby, Missouri.

L. Coon Hollow, Boone County, Arkansas.

Material dried at 103°.

	G.	H.	I.	J.	K.	L.
Insoluble	34.89	11.25	2.41	16.17	3.85	18.18
Soluble SiO_2	16.75	32.89	36.71	28.62	37.08	29.02
Al_2O_3	7.38	10.78	8.21	8.93	6.46	6.34
Fe_2O_3	10.34	3.89	2.75	5.98	3.49	4.40
ZnO	14.35	29.54	38.59	26.23	38.90	30.50
CaO	1.55	2.65	2.77	2.01	2.56	1.91
MgO	.35	.90	.78	.46	.42	.75
Ignition	10.37	8.22	7.99	9.19	7.52	8.36
	95.98	100.12	100.21	97.59	100.28	99.46

COLORADO.

A. Loess, Denver.

B. Loess, Highland.

C. Concretion in loess, Wray.

A, B, and C collected by S. F. Emmons, analyses by L. G. Eakins, record No. 1066.

D. Clay, Davis ranch, Pueblo quadrangle.

E. Clay, head of Rock Creek, Pueblo quadrangle.

D and E collected by G. K. Gilbert, analyses by George Steiger, record No. 1457.

	A.	B.	C.	D.	E.
SiO_2	69.27	60.97	70.63	63.52	76.56
Al_2O_3	13.51	15.67	10.43	24.72	8.30
Fe_2O_3	3.74	5.22	2.58	.43	.38
FeO	1.02	.35	.48	....	....
MgO	1.09	1.60	1.13	.13	.24
CaO	2.29	2.77	4.64	.30	.12
Na_2O	1.70	.97	1.29	trace	trace
K_2O	3.14	2.28	2.50	trace	trace
H_2O at 100°	4.19	9.83	3.77	1.58	1.26
H_2O above 100°				8.41	4.40
TiO_2	....	....	....	.68	.60
P_2O_5	.45	.19	.20	trace	.06
MnO	trace	trace	....	....	....
CO_2	trace	.31	2.59	....	....
Organic matter	....	....	....	.40	8.31
	100.40	100.16	100.24	100.17	100.23

F. From Red Creek Canyon, south part Colorado Springs quadrangle.

G. From 2 miles southeast of F.

H. From near Canyon.

I. Overlying H.

Collected as probable fire clays by G. K. Gilbert. Analyses by George Steiger, record No. 1578. Fe_2O_3 represents total iron. Al_2O_3 includes TiO_2. In I, the ignition includes some CO_2, which is absent from the others.

	F.	G.	H.	I.
SiO_2	85.09	86.79	57.98	69.04
Al_2O_3	6.98	8.29	27.51	14.51
Fe_2O_3	1.10	.75	1.68	3.78
MgO	.27	.13	.32	.73
CaO	.21	.34	.42	1.24
Na_2O	none	none	.03	.08
K_2O	.13	.25	.56	.48
Ignition	6.37	3.78	11.80	10.50
P_2O_5	.06	.05	.06	.07
	100.21	100.38	100.36	100.43

J to K. Supposed fire clays collected in the area of the Apishapa sheet, by G. K. Gilbert. Analyses, partial, by H. N. Stokes, record No. 1503. Titanium present, alkalies undetermined. Analyses made on ignited material, reckoned as 100. The loss on ignition is separately stated below each analysis.

	J.	K.	L.	M.	N.
SiO_2	86.58	78.07	76.96	61.98	93.11
Al_2O_3	12.72	20.22	20.77	37.51	5.56
Fe_2O_3	.45	.89	1.11	.45	1.15
MgO	.11	.26	.32	.09	.10
CaO	.11	....	.71	.19	.32
	98.97	99.44	99.87	100.22	100.24
Ignition	4.75	7.51	7.98	12.51	4.45

	O.	P.	Q.	R.
SiO_2	85.98	85.25	54.93	58.56
Al_2O_3	13.67	11.45	43.65	39.17
Fe_2O_3	.41	2.24	.69	.55
MgO	....	.21	.05	.45
CaO	.21	.26	.64	1.08
	100.27	99.41	99.96	99.81
Ignition	5.07	4.81	16.80	19.58

S. Loess-like alluvium, Golden, Jefferson County.

T. Fire clay, Golden, Jefferson County.

Analyses S and T made by W. F. Hillebrand in the Denver laboratory.

	S.	T.
SiO_2	72.31	50.35
Al_2O_3	12.66	34.44
Fe_2O_3	4.67	.75
MgO	.94	trace
CaO	1.15	....
Na_2O	2.47	.10
K_2O	3.75	.48
H_2O+organic matter	1.80	13.88
P_2O_5	.23	....
	99.98	100.00

WYOMING, UTAH, NEW MEXICO.

A. Loess, Cheyenne, Wyoming. Analysis by L. G. Eakins, record No. 1066.

B. Adobe soil, Salt Lake City, Utah.

C. Adobe soil, Santa Fe, New Mexico.

D. Adobe soil, Fort Wingate, New Mexico.

Analyses B, C, and D by Eakins, Nos. 981, 99C.

	A.	B.	C.	D.
SiO_2	67.10	19.24	66.69	26.67
Al_2O_3	10.26	3.26	14.16	.91
Fe_2O_3	2.52	1.09	4.38	.64
FeO	.31			
MgO	1.24	2.75	1.28	.51
CaO	5.88	38.94	2.49	36.40
Na_2O	1.42	trace	.67	trace
K_2O	2.68	trace	1.21	trace
H_2O	5.09	1.67	4.94	2.26
P_2O_5	.11	.23	.29	.75
MnO		trace	.09	trace
CO_2	3.67	29.57	.77	25.84
SO_3		.53	.41	.82
Cl		.11	.34	.07
Organic matter		2.96	2.00	5.10
	100.28	100.35	99.72	99.97

NEVADA.

A. Grayish clay from Upper Lahontan lake beds, Humboldt River bridge, Mill City.

B. Grayish clay, Lower Lahontan beds, same locality. Analyses by T. M. Chatard, record Nos. 32, 33.

C. Adobe soil, Humboldt. Analysis by L. G. Eakins, record No. 981.

D. Halloysite, pale greenish, Lucia mining district, Elko County. Analysis by George Steiger, record No. 1472.

	A.	B.	C.	D.
SiO_2	56.30	50.70	44.64	42.11
Al_2O_3	16.52	19.01	13.19	33.83
Fe_2O_3	5.08		5.12	.04
FeO	....	....	....	.28
MgO	2.64	3.19	2.96	.30
CaO	5.45	10.26	13.91	.33
Na_2O	2.60	1.91	.59	....
K_2O	2.17	2.16	1.71	....
H_2O at 100°	9.78	13.03	3.89	6.54
H_2O at 200°				1.07
H_2O at 300°				1.26
H_2O, ignition				12.04
P_2O_5	....	....	.94	trace
MnO	....	....	.13	....
CuO	....	....	....	2.83
CO_2	....	....	8.55	....
SO_3	....	....	.64	....
Cl	....	....	.14	....
Organic matter	....	....	3.43	....
	100.54	100.26	99.84	100.63

CALIFORNIA, WASHINGTON, HAWAIIAN ISLANDS.

A. Sandy clay, Owens Lake, California.

B. Blue clay, Owens Lake, California. Analyses by T. M. Chatard, record No. 551.

C. Clay from foot of Rickey Hill, Kittle Falls, Stevens County, Washington. Analysis by W. F. Hillebrand, record No. 1428.

D. Lava soil, Diamond Head, Hawaiian Islands. Analysis by L. G. Eakins, record No. 888.

	A.	B.	C.	D.
SiO_2	53.24	54.92	62.74	32.88
Al_2O_3	10.84	11.25	16.45	12.02
Fe_2O_3	2.59	2.77	2.62	11.52
FeO	.77	.94	1.91	....
MgO	5.82	4.91	2.41	11.70
CaO	9.18	8.76	3.68	12.20
Na_2O	2.06	2.10	3.05	undet.
K_2O	2.64	2.77	3.53	undet.
H_2O at 110°	1.41	2.05	} 2.69	} 5.30
H_2O at redness	2.73	2.40		
TiO_2	.25	.30	....	....
P_2O_5	....	....	....	.24
MnO	.10	.08	trace	trace
SrO	....	....	trace	....
CO_2	8.75	7.24	.65	11.41
SO_3	.08	trace	....	....
Cl	.05	trace	....	.91
	100.51	100.49	99.73	98.18

INDEX TO ROCKS.

O

ADVERTISEMENT.

[Bulletin 168.]

The statute approved March 3, 1879, establishing the United States Geological Survey, contains the following provisions:

"The publications of the Geological Survey shall consist of the annual report of operations, geological and economic maps illustrating the resources and classification of the lands, and reports upon general and economic geology and paleontology. The annual report of operations of the Geological Survey shall accompany the annual report of the Secretary of the Interior. All special memoirs and reports of said Survey shall be issued in uniform quarto series if deemed necessary by the Director, but otherwise in ordinary octavos. Three thousand copies of each shall be published for scientific exchanges and for sale at the price of publication; and all literary and cartographic materials received in exchange shall be the property of the United States and form a part of the library of the organization; and the money resulting from the sale of such publications shall be covered into the Treasury of the United States."

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The map sheets represent a great variety of topographic features, and with the aid of descriptive text they can be used to illustrate topographic forms. This has led to the projection of an educational series of topographic folios, for use wherever geography is taught in high schools, academies, and colleges. Of this series the first two folios have been issued, viz:

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2. Physiographic types, by Henry Gannett, 1900, folio, consisting of the following sheets and 11 pages of descriptive text: Norfolk (Va.-N. C.), a coast swamp; Marshall (Mo.), a graded river; Lexington (Nebr.), an overloaded stream; Harrisburg (Pa.), Appalachian ridges; Poteau Mountain (Ark.-Ind. T.), Ozark ridges; Marshall (Ark.), Ozark Plateau; West Denver (Colo.), hogbacks; Mount Taylor (N. Mex.), volcanic peaks, plateaus, and necks; Cucamonga (Cal.), alluvial cones; Crater Lake special (Oreg.), a crater.

GEOLOGIC ATLAS OF THE UNITED STATES.

The Geologic Atlas of the United States is the final form of publication of the topographic and geologic maps. The atlas is issued in parts, or folios, progressively as the surveys are extended, and is designed ultimately to cover the entire country.

Under the plan adopted the entire area of the country is divided into small rectangular districts (designated *quadrangles*), bounded by certain meridians and parallels. The unit of survey is also the unit of publication, and the maps and descriptions of each rectangular district are issued as a folio of the Geologic Atlas.

Each folio contains topographic, geologic, economic, and structural maps, together with textual descriptions and explanations, and is designated by the name of a principal town or of a prominent natural feature within the district.

Two forms of issue have been adopted, a "library edition" and a "field edition." In both the sheets are bound between heavy paper covers, but the library copies are permanently bound, while the sheets and covers of the field copies are only temporarily wired together.

Under the law a copy of each folio is sent to certain public libraries and educational institutions. The remainder are sold at 25 cents each, except such as contain an unusual amount of matter, which are priced accordingly. Prepayment is obligatory. The folios ready for distribution are here listed.

No.	Name of sheet.	State.	Limiting meridians.	Limiting parallels.	Area, in square miles.	Price, in cents.
1	Livingston	Montana	110°–111°	45°–46°	3,354	25
2	Ringgold	Georgia Tennessee	85°–85° 30′	34° 30′–35°	980	25
3	Placerville	California	120° 30′–121°	38° 30′–39°	932	25
4	Kingston *a*	Tennessee	84° 30′–85°	35° 30′–36°	969	25
5	Sacramento	California	121°–121° 30′	38° 30′–39°	932	25
6	Chattanooga	Tennessee	85°–85° 30′	35°–35° 30′	975	25
7	Pikes Peak *a*	Colorado	105°–105° 30′	38° 30′–39°	932	25
8	Sewanee	Tennessee	85° 30′–86°	35°–35° 30′	975	25
9	Anthracite-Crested Butte.	Colorado	106° 45′–107° 15′	38° 45′–39°	465	50
10	Harpers Ferry	Virginia West Va. Maryland	77° 30′–78°	39°–39° 30′	925	25
11	Jackson	California	120° 30′–121°	38°–38° 30′	938	25
12	Estillville	Virginia Kentucky Tennessee	82° 30′–83°	36° 30′–37°	957	25
13	Fredericksburg	Maryland Virginia	77°–77° 30′	38°–38° 30′	938	25
14	Staunton	Virginia West Va.	79°–79° 30′	38°–38° 30′	938	25
15	Lassen Peak	California	121°–122°	40°–41°	3,634	25
16	Knoxville	Tennessee N. Carolina	83° 30′–84°	35° 30′–36°	925	25
17	Marysville	California	121° 30′–122°	39°–39° 30′	925	25
18	Smartsville	California	121°–121° 30′	39°–39° 30′	925	25
19	Stevenson	Alabama Georgia Tennessee	85° 30′–86°	34° 30′–35°	980	25
20	Cleveland	Tennessee	84° 30′–85°	35°–35° 30′	975	25
21	Pikeville	Tennessee	85°–85° 30′	35° 30′–36°	969	25
22	McMinnville	Tennessee	85° 30′–86°	35° 30′–36°	969	25
23	Nomini	Maryland Virginia	76° 30′–77°	38°–38° 30′	938	25
24	Three Forks	Montana	111°–112°	45°–46°	3,354	50
25	Loudon	Tennessee	84°–84° 30′	35° 30′–36°	969	25
26	Pocahontas	Virginia West Va.	81°–81° 30′	37°–37° 30′	951	25
27	Morristown	Tennessee	83°–83° 30′		963	25
28	Piedmont	Maryland West Va.	79°–79° 30′	39°–39° 30′	925	25
29	Nevada City:					
	Nevada City	California	121° 00′ 25″–121° 03′ 45″	39° 13′ 50″–39° 17′ 16″	11.65	50
	Grass Valley	California	121° 01′ 35″–121° 05′ 04″	39° 10′ 22″–39° 13′ 50″	12.09	
	Banner Hill	California	120° 57′ 05″–121° 00′ 25″	39° 13′ 50″–39° 17′ 16″	11.65	
30	Yellowstone National Park:					
	Gallatin Canyon Shoshone Lake	Wyoming	110°–111°	44°–45°	3,412	75
31	Pyramid Peak	California	120°–120° 30′	38° 30′–39°	932	25
32	Franklin	Virginia West Va.	79°–79° 30′	38° 30′–39°	932	25
33	Briceville	Tennessee	84°–84° 30′	36′–36° 30′	963	25
34	Buckhannon	West Va.	80°–80° 30′	38° 30′–39°	932	25
35	Gadsden	Alabama	86°–86° 30′	34°–34° 30′	986	25
36	Pueblo	Colorado	104° 30′–105°	38°–38° 30′	938	50
37	Downieville	California	120° 30′–121°	39° 30′–40°	919	25
38	Butte Special	Montana	112° 29′ 30″–112° 36′ 42″	45° 59′ 28″–46° 02′ 54″	22.80	50
39	Truckee	California	120°–120° 30′	39°–39° 30′	925	25
40	Wartburg	Tennessee	84° 30′–85°	36°–36° 30′	963	25
41	Sonora	California	120°–120° 30′	37° 30′–38°	944	25
42	Nueces	Texas	100°–100° 30′	29° 30′–30°	1,035	25
43	Bidwell Bar	California	121°–121° 30′	39° 30′–40°	918	25
44	Tazewell	Virginia West Va.	81° 30′–82°	37°–37° 30′	950	25
45	Boise	Idaho	116°–116° 30′	43° 30′–44°	864	25
46	Richmond	Kentucky	84°–84° 30′	37° 30′–38°	944	25
47	London	Kentucky	84°–84° 30′	37°–37° 30′	950	25
48	Tenmile District Special.	Colorado	106° 8′–106° 16′	39° 22′ 30″–39° 30′ 30″	55	25
49	Roseburg	Oregon	123°–123° 30′	43°–43° 30′	871	25
50	Holyoke	Mass Conn	72° 30′–73°	42°–42° 30′	885	50
51	Big Trees	California	120°–120° 30′	38°–38° 30′	938	25
52	Absaroka:					
	Crandall Ishawooa	Wyoming	109° 30′–110°	44°–44° 30′	1,706	25
53	Standingstone	Tennessee	85°–85° 30′	36°–36° 30′	963	25

a Out of stock.

No.	Name of sheet.	State.	Limiting meridians.	Limiting parallels.	Area, in square miles.	Price, in cents.
54	Tacoma	Washington.	122°-122° 30′	47°-47° 30′	812	25
55	Fort Benton	Montana	110°-111°	47°-48°	3,273	25
56	Little Belt Mts	Montana	110°-111°	46°-47°	3,295	25
57	Telluride	Colorado	107° 45′-108°	37° 45′-38°	236	25
58	Elmoro	Colorado	104°-104° 30′	37°-37° 30′	950	25

STATISTICAL PAPERS.

Mineral Resources of the United States, 1882, by Albert Williams, jr. 1883. 8°. xvii, 813 pp. Price 50 cents.

Mineral Resources of the United States, 1883 and 1884, by Albert Williams, jr. 1885. 8°. xiv, 1016 pp. Price 60 cents.

Mineral Resources of the United States, 1885. Division of Mining Statistics and Technology. 1886. 8°. vii, 576 pp. Price 40 cents.

Mineral Resources of the United States, 1886, by David T. Day. 1887. 8°. viii, 813 pp. Price 50 cents.

Mineral Resources of the United States, 1887, by David T. Day. 1888. 8°. vii, 832 pp. Price 50 cents.

Mineral Resources of the United States, 1888, by David T. Day. 1890. 8°. vii, 652 pp. Price 50 cents.

Mineral Resources of the United States, 1889 and 1890, by David T. Day. 1892. 8°. viii, 671 pp. Price 50 cents.

Mineral Resources of the United States, 1891, by David T. Day. 1893. 8°. vii, 630 pp. Price 50 cents.

Mineral Resources of the United States, 1892, by David T. Day. 1893. 8°. vii, 850 pp. Price 50 cents.

Mineral Resources of the United States, 1893, by David T. Day. 1894. 8°. viii, 810 pp. Price 50 cents.

On March 2, 1895, the following provision was included in an act of Congress:

"*Provided*, That hereafter the report of the mineral resources of the United States shall be issued, as a part of the report of the Director of the Geological Survey."

In compliance with this legislation the following reports have been published:

Mineral Resources of the United States, 1894, David T. Day, Chief of Division. 1895. 8°. xv, 646 pp., 23 pl.; xix, 735 pp., 6 pl. Being Parts III and IV of the Sixteenth Annual Report.

Mineral Resources of the United States, 1895, David T. Day, Chief of Division. 1896. 8°. xxiii, 542 pp., 8 pl. and maps; iii, 543-1058 pp., 9-13 pl. Being Part III (in 2 vols.) of the Seventeenth Annual Report.

Mineral Resources of the United States, 1896, David T. Day, Chief of Division. 1897. 8°. xii, 642 pp., 1 pl.; 643-1400 pp. Being Part V (in 2 vols.) of the Eighteenth Annual Report.

Mineral Resources of the United States, 1897, David T. Day, Chief of Division. 1898. 8°. viii, 651 pp., 11 pl.; viii, 706 pp. Being Part VI (in 2 vols.) of the Nineteenth Annual Report.

Mineral Resources of the United States, 1898, David T. Day, Chief of Division. 1899. 8°. viii, 616 pp.; ix, 804 pp., 1 pl. Being Part VI (in 2 vols.) of the Twentieth Annual Report.

The money received from the sale of the Survey publications is deposited in the Treasury, and the Secretary of the Treasury declines to receive bank checks, drafts, or postage stamps; all remittances, therefore, must be by MONEY ORDER, made payable to the Director of the United States Geological Survey, or in CURRENCY—the exact amount. Correspondence relating to the publications of the Survey should be addressed to—

THE DIRECTOR,
UNITED STATES GEOLOGICAL SURVEY,
WASHINGTON, D. C.

WASHINGTON, D. C., *May, 1900.*